TECHNOLOGY DEPARTMENT

NOVEMBER, 1947

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Plant Engineering

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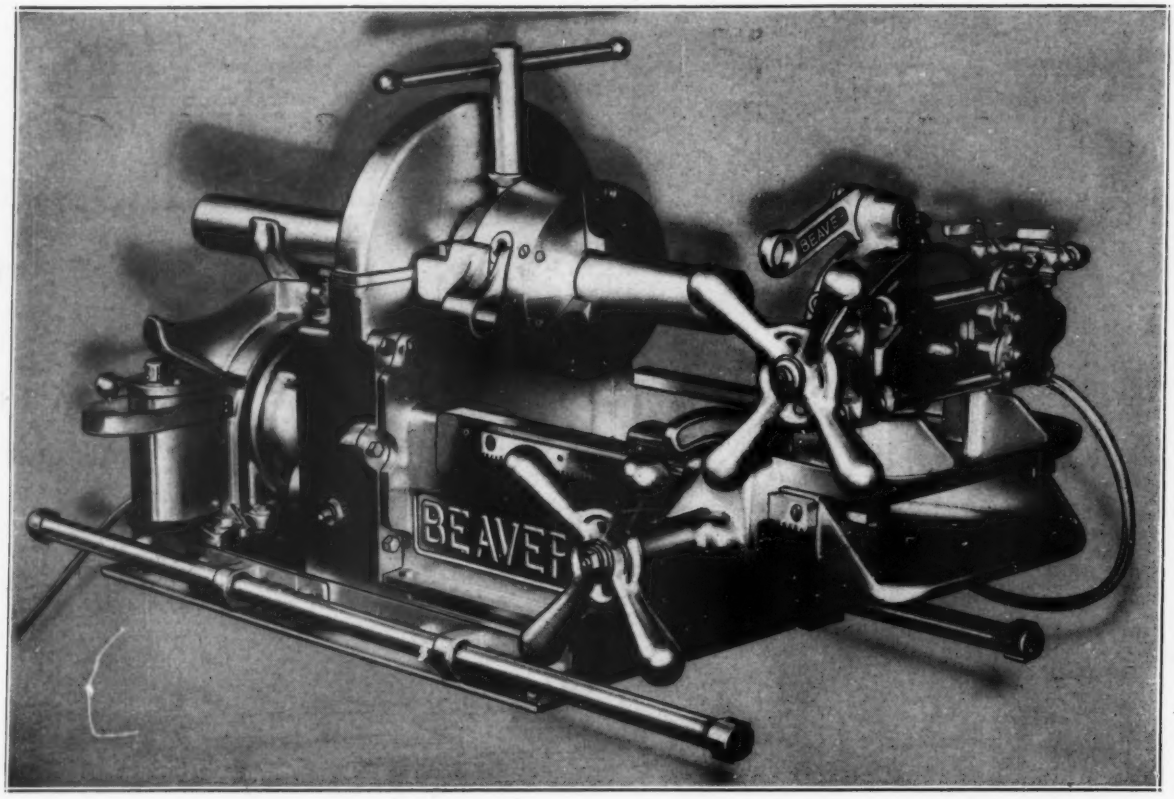
Vol. 1, No. 1. Circulation of this issue—28,374

The magazine that helps plant engineers with their everyday problems

✓R v. 1-2 Nov. 1947 - Dec. 1948

THE BEAVER MODEL A - A High Speed Heavy Duty

⅛ to 2-inch Portable Pipe and Bolt Machine with Dual Automatic Oiling



186 different kinds

and sizes of dies
are available to users of
Beaver Models A and B
Pipe and Bolt Machines!

Tech

BEAVER PIPE TOOLS

210 DANA AVENUE — 47 YEARS OF HIGHEST QUALITY — WARREN, OHIO, U. S. A.

Plant Engineering is published monthly at 53 W. Jackson Blvd., Chicago 4, Ill. Subscription price $10.00 per year to U. S. A., $11.00 to Canada, $12.00 to other countries. Single copy $1.00. Application is pending for acceptance under Act of June 5, 1934.

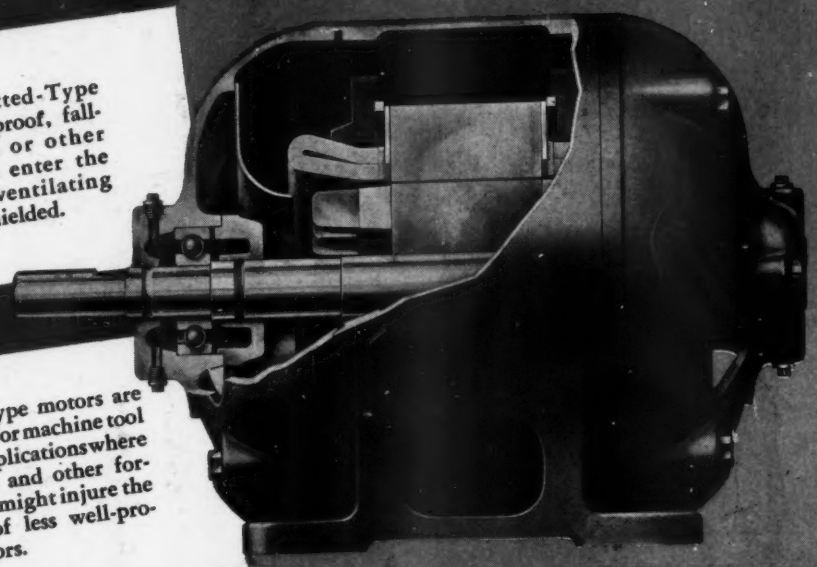
When and Where you should use . . .

WHERE THERE IS DRIPPING LIQUID

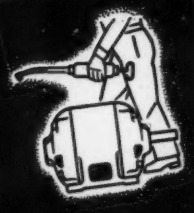
Because Protected-Type motors are dripproof, falling water, oil or other liquids cannot enter the windings. All ventilating openings are shielded.

WHERE THERE ARE FALLING CHIPS

Protected-Type motors are tailor-made for machine tool and other applications where metal chips and other foreign matter might injure the windings of less well-protected motors.

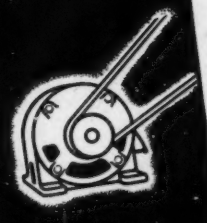


WHEN INSPECTION VISITS ARE FEW AND FAR BETWEEN



Because rotors are practically indestructible; because stator windings are dirt, oil and moisture resistant to a high degree; because bearing seals are so effective that regreasing is required only once a year or even less frequently—Protected-Type motors require *minimum maintenance.*

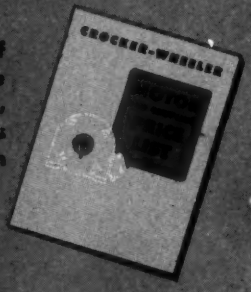
FOR ALL GENERAL-PURPOSE APPLICATIONS



Rated 40C rise, full-load continuous duty, with a 15 per cent overload factor, these motors are suitable for all general-purpose applications for horizontal, vertical or wall mounting. Available in standard ratings from 1 to 1000 hp.

CROCKER-WHEELER *protected-type* MOTORS

Ask for your FREE copy of new, handy, 8-page price list that gives prices, weights and dimensions of standard motors in sizes up to 75 hp.



Quality Motors and Generators Since 1888

YOU CAN GET FROM CROCKER-WHEELER:

Polyphase Induction Motors, 1 to 10,000 hp.
Direct Current Motors, 1 to 5,000 hp.
Alternating Current Generators, 500 to 10,000 kva.
Turbo Generators, 1875 to 12,500 kva.
Direct Current Generators, 1 to 3000 kw.
Motor-Generator Sets, 1 to 6000 kw.
Flexible Couplings, for shaft diameters up to 8".

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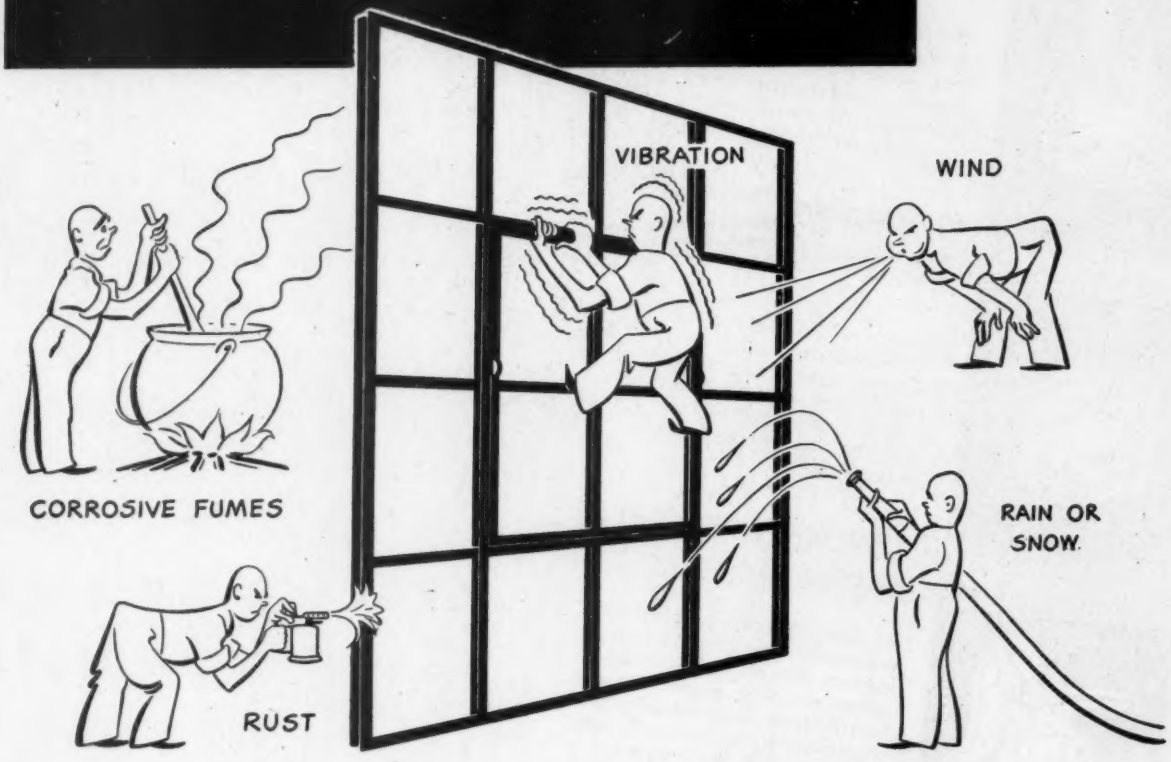
ELECTRIC MANUFACTURING COMPANY, AMPERE, N. J.

A Division of Joshua Hendy Corporation

Branch Offices: Boston, Chicago, Cincinnati, Cleveland, Los Angeles, New York Philadelphia, Pittsburgh — Representatives in Principal Cities

WHERE WINDOWS TAKE A BEATING...



HOPE'S LOK'D BAR STEEL SASH STAND UP!

Factory and railroad smoke contains sulphuric acid, chemical processes give off fumes; these and other corrosives are always at work in every industrial area. Rain brings rust; wind and everyday banging shut of ventilators add plenty of wear and tear . . . forces that conventional light steel sash just can't resist.

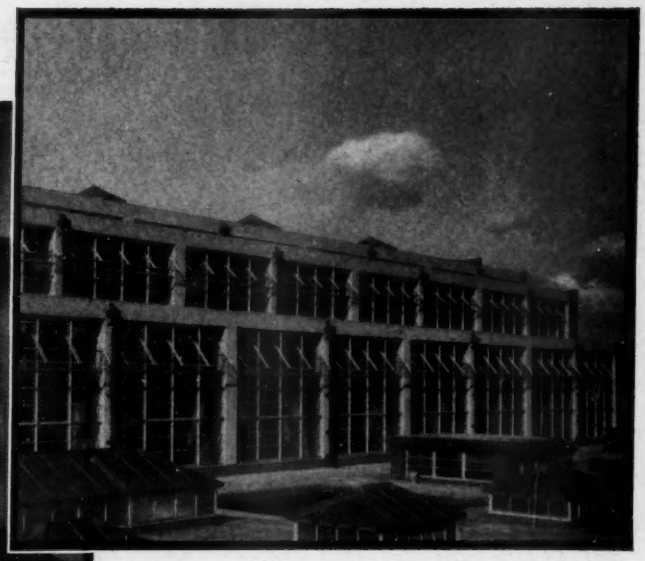
Look closely at the items and costs of repairs to your factory windows and you'll find two things cost you extra money: 1) just plain lack of strength, 2) corrosion, frequently starting with the applied weathering strips around the ventilators.

To reduce trouble and up-keep expense, specify Hope's Lok'd Bar Steel Factory Sash when replacing or building new. You'll get the most enduring windows at the lowest final cost. You'll also get windows that are really weather-tight . . . guaranteed against infiltration higher than one cu. ft. air per minute at wind velocity of 25 m. p. h.

You'll find proof of these advantages in the details of design and construction on the opposite page. Users of Hope's Windows, especially in such harsh conditions as chemical plants, meat packing and in sea-shore exposures, provide the final test of experience. Ask your architect and builder. He has probably had actual experience with Hope's Windows.

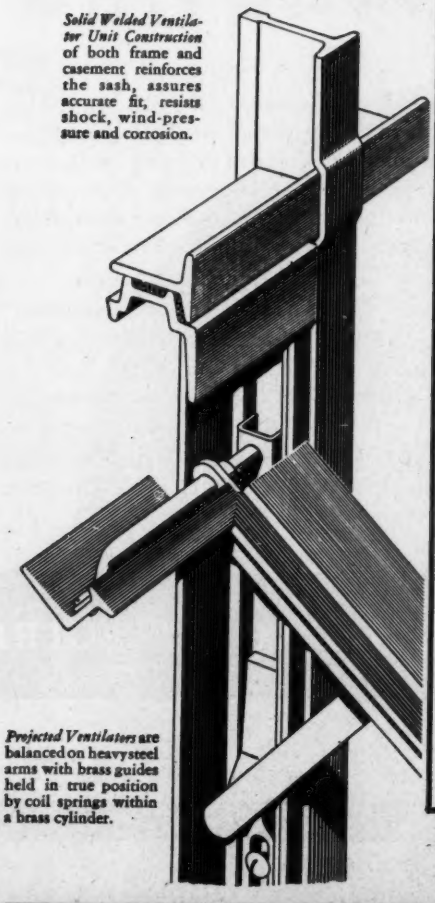
HOPE'S WINDOWS, INC., JAMESTOWN, N. Y.

Hope's Lok'd Bar Steel Sash with ventilator operating gear electrically-controlled.

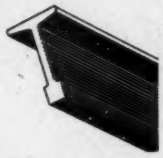


Hope's Lok'd Bar Steel Sash with ventilator operating gear manually controlled.

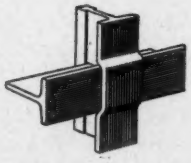
Solid Welded Ventilator Unit Construction of both frame and casement reinforces the sash, assures accurate fit, resists shock, wind-pressure and corrosion.



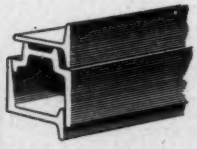
Projected Ventilators are balanced on heavy steel arms with brass guides held in true position by coil springs within a brass cylinder.



Strong, Heavy, Vertical Sash Bars . . . Bulb Tee Section Bars give greater strength for the weight of their metal; the starting point in designing a window that makes large glazed wall areas a safe and enduring construction.

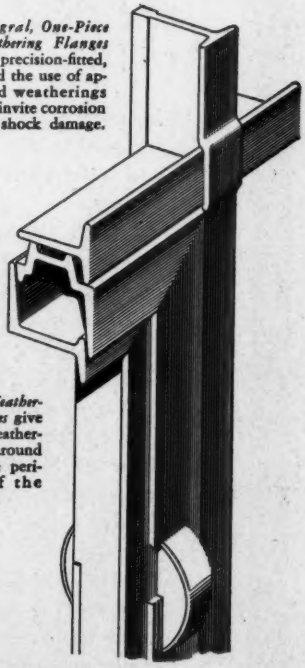


Hope's Lok'd Bar Joint . . . Threading the flat tee horizontal muntin thru the vertical bulb tee gives sash more strength in proportion to steel used and least harmful distortion of metal.



Hope's Integral Ventilator Sections give broad, double, weathertight contacts all around the ventilators, reduce wind infiltration, increase weathertightness; no parts to work loose or rust away.

Integral, One-Piece Weathering Flanges . . . precision-fitted, avoid the use of applied weatherings that invite corrosion and shock damage.



Integral Weathering Flanges give double weathertightness around the entire perimeter of the ventilator.

Solid Bronze Cup Pivots, stronger, neater, cannot stick or jam and are the only pivots which make perfectly weathertight joints.

MAIL THIS COUPON TODAY

Hope's Windows, Inc., Jamestown, N. Y. **PE-1147**

Please send descriptive Literature featuring Hope's Windows in industrial installations.

Name_____

Address_____

1818 — *The Name Guarantees* — 1947

the *Load* outgrew the system

The Solution Was This

Voltage conditions became good all over the production area as soon as this G-E load-center unit relieved the overloaded, long secondary feeders.

Installed right at the center of the load area, it receives 13,200-volt power from the utility, distributes it at 480 volts to the motor loads through *short* secondary feeders.

The plant engineers like its compact, metal-enclosed construction that enabled them to install it in unused space between columns, right on the factory floor. They like the easy-to-operate drawout breakers, too, which have adequate interrupting capacity to properly safeguard production against the heavy losses caused by power interruptions.

F. W. Hardenstine, the Chief Electrician, says, "The unit substation gives us power when we want it, where we want it. Installing it was merely a matter of moving it off the freight car, setting it in place and connecting the cables."

Your G-E sales representative will gladly help you with your next plant distribution problem. His recommendations will be based on General Electric experience in equipping thousands of load-center power systems that give their plants greater safety and operating economy at less cost.

These bulletins are available on request:

GEA-3592—"Load-center Unit Substations"

GEA-3758—"What Load-center Power Distribution Can Do For You"

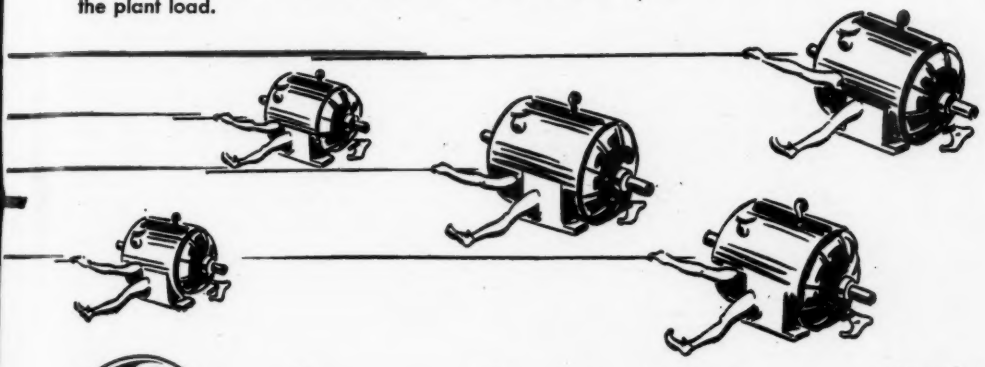
GEA-4085—Load-center Unit Substations For Semi-hazardous Locations

Ask your G-E sales representative, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

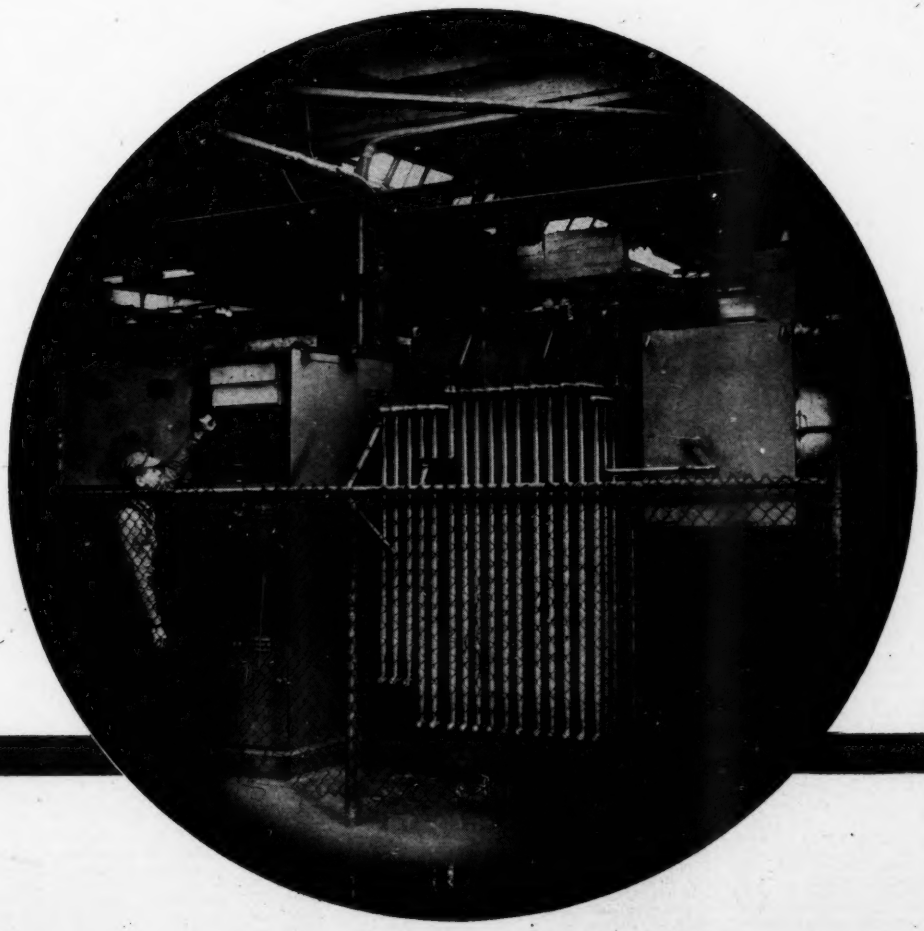
221-47

GENERAL ELECTRIC

The secondary circuits were badly overloaded in the plant of the Union Wire Rope Corporation, Kansas City, Mo. Voltage drops were severe—and costly. What's more, the fast-growing plant needed new equipment that was soon to add 600 HP to the plant load.



Load-center Unit!



Bulletins . . . . Catalogs

When you want copies of any of the bulletins described on these pages remove one of the cards between pages 18 and 19 and pages 66 and 67. Please fill in completely in order to assist the manufacturer in complying promptly with your request.

MAINTENANCE

Refer to 11-1

Corrosion Inhibitor—Technical Data Sheet F-5027-B presents technical information on Morlex corrosion inhibitors for steam boilers and steam heating systems. Specifications and properties of the material are presented in tabular form and the action of the inhibitor in water solutions is described. Concentrations of the corrosion inhibitor necessary to obtain stated pH values in the boiler water and the steam generator are given in a table. Carbide and Carbon Chemicals Corp.

Refer to 11-2

Vacuum Cleaners—Two new four-page bulletins on vacuum cleaners for boilers and furnaces have just been issued. Bulletin No. 137 describes a stationary vacuum cleaning unit for removing soot from return tubular or sectional boilers and Bulletin No. 117 describes a portable vacuum cleaning unit for furnaces and boilers. The Spencer Turbine Co.

Refer to 11-3

Concrete Masonry Waterproofing—A major problem in industry is the waterproofing of concrete masonry, especially where the masonry is under hydrostatic pressure as it so often is in power plants. This 16-page bulletin tells what this company's product is, how it works, and shows methods of applying. Photostatic evidence shows how the product enables concrete masonry to withstand hydrostatic pressure tests of 500 psi. Object of the tests is described and procedure, observations and conclusions are given. Some examples of the use of the product, Aquella, in concrete masonry construction are shown in photographs. Prima Products, Inc.

Refer to 11-4

Antifoaming Compound—This new pamphlet" from the company's "Silicone Notebook" describes the physical properties of DC Anti-Foam A which was recently developed for killing foam in aqueous systems. The company points out that the compound has proved its usefulness in a wide variety of industrial processes including steam distillation and vacuum evaporation. Physical properties of the compound are described and directions on how to use it are given. Tables and charts how to use it are given. Dow Corning Corp.

Refer to 11-5

Tank Linings—An emulsion for coating the interior of cold and hot water tanks is described in this 4-page folder. Features of the emulsion such as bonds to damp or dry surfaces; stops rust, corrosion and electrolysis; remains rubbery and pliable; will not rub off after drying, etc., are listed. Photographs show the interiors of tanks on which the emulsion has been applied. A detailed description of porcelain line coating is given. How E. Baker Co.

Refer to 11-6

Corrosion Bulletin—A bulletin titled, "Prevention of Corrosion in Steam and Condensate Return Lines," was issued recently by this company. The bulletin discusses the reasons for corrosion in these lines and analyzes the type of treatment necessary to combat it. Instructions for use of the treatment—feeding, dosage and control test—are presented and a few words of caution are inserted. E. F. Drew & Co., Inc.

Refer to 11-7

Building Maintenance Handbook—These 32 pages of practical information and guidance have just been issued by this company. This illustrated catalog is virtually a handbook which outlines specific maintenance problems and explains how each product may best be used to solve these problems. There are four distinct sections: (1) on products that will preserve and improve floors of all types, (2) on protective and decorative coatings for exteriors and interiors of buildings and installations, (3) on heat system, water system and metal conditioners, (4) on industrial cleaners and disinfectants. Continental Asbestos & Refining Corp.

Refer to 11-8

Protective Coatings Bulletin—Details and uses of this new plastic protective coating that waterproofs and vapor seals are given in this 4-page, 2-color pamphlet. The bulletin lists the product's special adaptability for use on above-ground tanks, gas holders, railings, fire escapes, storage tanks and towers, cooling towers, etc., and also tells about its ability to damp-proof wall surfaces. Walles-Dove-Hermiston Corp.

Refer to 11-9

Motor-Operated Doors—The power units which operate these doors, and the doors themselves, are covered in this recently-issued 8-page Bulletin S-17. Emergency manual operation of the door is covered and excellent illustrations of the operating units are presented; these illustrations are used as a vehicle for calling attention to some of the outstanding features of the units' construction. Mounting details for wall and bracket mounted types of units are portrayed by means of line drawings and appropriate descriptive material. The Kinnear Mfg. Co.

Refer to 11-10

Metallizing—"Metallizing Unlimited" is the title of this 8-page booklet that tells what metallizing is, describes various metallizing applications, tells about the equipment used in metallizing and how it works. Other data given include interesting facts and figures about metallizing and shows how the company's engineers give personal instruction in the use of the equipment. Industry classifications from the U. S. Census are used to show in what industries the equipment is in daily use. Metallizing Engineering Co., Inc.

ELECTRICAL

Refer to 11-11

Electronic Servo Systems—Technical Bulletin S-138 covers this company's electronic servo systems for the remote positioning of dampers, valves and other mechanisms. The bulletin starts out by describing the principle upon which the servo mechanism is built and presents line diagrams which show, as simply as possible, the various types of hookups. Dimensioned drawings and tables of construction detail are given. Askania Regulator Co.

Refer to 11-12

Voltage Control—Bulletin 547 is a 12-page booklet covering voltage and control instruments, variable transformers, powerstats and voltage regulators. Performance data of the various units are shown in charts and construction details are indicated by accompanying line drawings. Detailed descriptions of all the units are given. One full page of connection arrangements is presented and a full-page table of ratings, in tabular form, are published. The Superior Electric Co.

Refer to 11-13

Intraplant Communication—Intraplant communication is completely covered in a group of folders issued recently. The manufacturer's Operadio Soundcaster, Plant Broadcaster and Flexiphone intercommunication systems are dealt with thoroughly. Principles of operation and details of construction are given and photos illustrate each feature mentioned. Operadio Manufacturing Co.

Refer to 11-14

Induction Motors Bulletin—These two Bulletins C-118 and C-125, have just been issued. Both are 4-page catalogs and cover the company's "Series C" induction motors. Details of construction are emphasized and excellent wash drawings and line drawings are used for illustrative purposes. Protective insulation treatment is described in detail. A table of ratings is given. Reliance Electric & Engineering Co.

Refer to 11-15

Electronic Servomechanism—Illustrated and described in this catalog sheet is the company's new electronic servomechanism, Motron. The bulletin tells how the unit may be applied to the automatic control or regulation of a large variety of practical problems to eliminate the need of human supervision. Suggested uses such as air velocity control for sizing of coal and tracer controlled mechanisms such as oxy-acetylene cuttings are listed. W. C. Robinette Co.

Refer to 11-16

Protected Type Motors—Bulletin SL-300-1, gives information on this company's new protected type motor. A large cutaway illustration of the motor is used as a vehicle for calling attention to the 11 major constructional advantages of the unit. The last page of the folder shows "when and where to use protected type motors." Crocker-Wheeler Div., Joshua Hendy Iron Works.

Refer to 11-17

Circuit Breakers Bulletin—This new multi-breaker has been designed for apartments, stores, garages, churches, schools, small factories, etc. Features of the unit are described by means of cutaway illustrations which have the various parts labeled. Advantages of the breaker are further described in the accompanying copy. The back portion of the booklet shows the ease with which the breaker may be installed or serviced. Cutler-Hammer, Inc.

Refer to 11-18

Power Transformers—This Bulletin TU-181 is a collection of several smaller bulletins each of which covers one particular transformer. Besides the complete constructional and rating data given in the bulletins the back portion of the collection presents information of general engineering interest. Wagner Electric Corp.

Refer to 11-19

Steel Fabricated Motor—This 4-page Bulletin L-12 describes the latest development in this company's steel fabricated motor, a standardized unit engineered for "low maintenance, high performance and service life." The center spread of the folder points out the various construction features which differ from conventional motors. The section is illustrated with a large wash drawing. Typical installations are pictured. Elliott Co.

MECHANICAL POWER TRANSMISSION

Refer to 11-20

Adjustable Speed Drive—Bulletin 311-A, describes this company's all-electric adjustable speed drive for a-c circuits. This particular bulletin is concerned with 40 to 200 h.p. units and it describes the application of the units in reversing, jogging, threading and quick stopping, all by convenient push button control. The bulletin describes the control unit, motor, speed adjuster, methods of operation, and acceleration to fit the work. Some of these features are illustrated by means of photographs. The back page of the bulletin shows the 3 components—control unit, the motor and the operator's station. Reliance Electric & Engineering Co.

Refer to 11-21

Bronze Pillow Blocks—This 8-page bulletin describes the company's line of self-aligning, bronze pillow blocks and flange units. The greater proportion of the bulletin is devoted to tables of dimensions and dimensioned drawings of the units. A complete description of the overall features of the line of pillow blocks and flange units is presented on the inside front cover. Anti-Friction Bearings Co.

Refer to 11-22

Speed Reducers, Transmissions—Bulletin 10,000 is a condensed catalog of the products, services and facilities of this company. Included in the description are precision gears, speed reducers, high speed drives, transmissions, special gear drives

and many similar products. Each of these pieces of equipment included is described briefly and photographs are included. Details of construction of the company's steeliflex couplings are given prominent display in the center of the booklet. Many drawings are included and construction features are covered fully. The Falk Corp.

Refer to 11-23

Flexible Couplings Bulletin—There are four pages in this bulletin which describes the company's Series A flexible coupling. A cut-away wash drawing of the coupling shows some of the unit's construction features. Engineering information includes tables and drawings of dimensions, a table of standard gear coupling ratings, listing of service factors. John Waldron Corp.

Refer to 11-24

Couplings Data Book—Catalog No. 46, 52 pages, is spirally bound in a separate heavy paper cover; it provides complete engineering and catalog information on the company's line of self-alining couplings. An illustrated index of the available types of couplings is presented in the front part of the booklet. Information on the solving of misalinment probments, on the company's particular design and principles of lubrication, etc., follow. Complete material and dimension information on each coupling also is included. Bartlett Hayward Div., Koppers Co., Inc.

Refer to 11-25

Flexible Coupling Data—Available now to engineers and other interested officials is the revised edition of this company's flexible couplings catalog. It shows the entire line of the company's couplings from 1/6 to 2500 hp and presents considerable engineering information. "Selector Charts" included with the catalog show instantly the exact coupling for every job along with prices, bores, sizes and other pertinent data. Lovejoy Flexible Coupling Co.

PUMPS, COMPRESSORS

Refer to 11-26

Centrifugal Pumps—Bulletin 710-1, 12 pages, describes "Close-Cupid" centrifugal pumps. The front part of the booklet lists the advantages of these pumps and this is followed by two detailed tables on materials of construction. A complete discussion of the specifications is given with illustrations. Twenty-four performance charts showing ratings within efficiency curves and two tables on dimensions accompanied by line drawings help to present a clear picture of the units' characteristics. Gould Pumps, Inc.

Refer to 11-27

Centrifugal Pumps—Bulletin 225-Revised is a 4-page booklet describing the company's single stage, double suction centrifugal pumps Type DB and DBM. Specifications of both of these units are covered and sectional views with various parts labeled are presented in the inner spread. Tables of dimensions and drawings plus a rating table in U. S. Gallons Per Minute at various heads from 20 to 170 feet are given on the back page of the folder. Warren Steam Pump Co., Inc.

Refer to 11-28

Compressors Data Book—There are 64 pages in this recently-issued Bulletin 3080 on the company's Class PRE synchronous-motor-driven compressors. Complete coverage of the construction and operating advantages of the units is given in the first several pages. Full-page compilations of important advantages resulting from these design features also are given. Extremely large and clear full-color illustrations render the explanations easy to follow. Typical installations are pictured. Ingersoll-Rand.

Refer to 11-29

Multi-Stage Pumps—Catalog B-1146 deals with the company's vertically split-case multi-stage pumps which are built for capacities from 50 to 200 gpm. Six large performance curves for the 2½ by 1½ CS pumps are presented and complete details of construction, accompanied by line drawings, are given. A table of approximate weights and dimensions is printed. Economy Pumps, Inc.

Refer to 11-30

Spotting Air Where Needed—Bulletin C-5 describes Fuller rotary air compressors; shows how these compressors, "spotted where you need air," eliminate the cost of long pipe lines, insure savings in power and maintenance. Fuller Co.

Refer to 11-31

Jet Pumps Data Bulletin—A simple, time-saving method of determining the correct type of jet pump for the user's individual requirements is a feature of Bulletin 315. The bulletin details the manner in which this line of jet pumps, utilizing water under pressure as the pumping medium, is used in the transfer, removal or mixing of liquids, heavy sludges, process wastes and fluids containing substances injurious to conventional pumping equipment. Also included are charts and tables to facilitate proper selection over a wide range of conditions. Derbyshire Machine & Tool Co.

HEATING, COOLING

Refer to 11-32

Direct-Fired Unit Heaters—Bulletin 516 contains 12 pages and completely describes a line of direct fired, oil or gas burning unit heaters. Efficiency of the units' design, and distribution of heat are stressed and the bulletin points out in considerable detail the advantages of "counter flow" combustion. The stainless steel combustion chamber also is stressed. 18 points of construction are described in detail. Drawings show ease of installation and manner of deciding location in buildings. Tables of capacity and dimension are given and complete and detailed list of specifications is printed. Dravo Corp.

Refer to 11-33

Hot Water Storage Heaters—Catalog 17, 20 pages in a separate paper cover, describes the company's line of hot water storage heaters and preheaters. Descriptions of the equipment cover standard construction details. Tables present information on capacities and weights and clearance dimensions. Conversion tables for help in determining the heating capacity of various sections of the heaters also are given. Still more information is included in the sections titled: Hot Water Consumption for Various Types of Buildings, Steam Required to Heat Water. The Patterson-Kelley Co., Inc.

Refer to 11-34

Heating, Ventilating, Air Conditioning—This company's products for heating, ventilating and air conditioning which are used in a variety of installations from department stores and office buildings to aviation wind tunnel testing are presented in Bulletin 25B6183. Photographs of installations of motors driving refrigerating machines and large ventilating fans, variable pitch sheaves, centrifugal pumps, various types of motors, transformers and controls are given. Allis-Chalmers Mfg. Co.

Refer to 11-35

Oil, Gas Burners—General Bulletin 745 is a recently-issued 12-page bulletin which tells about application of the company's line of oil and gas burners for industrial plants, public buildings, etc. The booklet starts off with photos of typical installations and then describes the details of the burners' construction. All parts of the burners are described and tables of sizes and rated capacities are included. Each part is illustrated. More complete details on the items, it is pointed out, are available in other bulletins. National Airoil Burner Co., Inc.

TREATMENTS

Refer to 11-36

Stopping Scale Without Chemicals—This bulletin tells about the company's electro neutralizer which is reported to stop scale without the use of chemicals in boilers, condensers, evaporators, internal combustion engines, Diesel installations and hot water systems. The operation of the neutralizer is completely explained and the principle of electro-neutralization is covered. Electro Chemical Engineering Co.

Refer to 11-37

Fuel Treatments—These two bulletins describe the company's chemical treatments for fuel oil (to prevent sludge formation) and for removing soot from coal, wood or oil-fired combustion systems. The first bulletin describes the action of the sludge removing chemical and tells what it will accomplish for the user. A description of how to use the chemical is given. The second bulletin shows the dollar value of heat wasted with varying thicknesses of soot deposit. Magnus Chemical Co., Inc.

Refer to 11-38

Boiler Water Conditioning Booklet—This 12-page booklet defines terms and describes and reviews the objectives in boiler water

Bulletins . . . Catalogs

conditioning. Many questions are asked by the booklet which then proceeds to answer them—questions such as "Is a softened water the ideal boiler water?" A solution to industrial water treating problems is proposed. Union Chemical & Oil Co.

VALVES, TRAPS

Refer to 11-39

Water Temperature Controls—These two 4-page folders, describing the advantages and construction of this company's thermostatic mixing valves and water controllers, have just been issued. The bulletins show how sudden surges of scalding water in gang showers and wash fountains are a constant danger to employes. List prices, capacities and weights of the valves are presented in tabular form and a chart for determining the size of the controller for any particular installation is given. The Powers Regulator Co.

Refer to 11-40

Heating, Valves, Traps, Controls—The complete line of this manufacturer's heating specialties including venting valves, thermostatic traps, float traps, supply valves, vacuum and condensation pumps, etc., are covered in this new 8-page general catalog. Tables of capacities, weights and sizes are presented and illustrative material consists of line drawings and photographs. Hoffman Specialty Co.

Refer to 11-41

Steam and Water Valves—This 4-page bulletin describes seven types of valves—examples of the more than 1500 standard types and sizes made by this company. Line diagrams picture the valve as installed and sectional wash drawings picture the valve itself. Brief descriptions of the unit are given and their outstanding features are listed. Golden-Anderson Valve Specialty Co.

Refer to 11-42

Valves, Fittings, Manifolds—Catalog R2 is a 20-page bulletin which describes and illustrates globe valves, line valves, charging, purging or drain valves, check valves, liquid indicators, valve manifolds, refrigerant cylinder valves, compressor valve dehydrators, filters, and other items of a similar nature. Each piece of equipment is accompanied by tables giving pertinent data, list prices, weights and code words. Many types of fittings are included in the booklet. Superior Valve & Fttings Co.

Refer to 11-43

Air Inlet Valves—Described by the company as the first bulletin ever to contain complete data on the use of air inlet valves is Bulletin 125. All facts needed to put air inlet valves into use as protection against collapse of thin-walled, gravity flow pipe lines are contained in the booklet. Full page alinement charts make easy many of the calculations. The booklet contains 16 pages. The Simplex Valve & Meter Co.

Refer to 11-44

Inner Valves—Bulletin A-100 pictures and describes the company's Micro-Flute and Micro-Form "PUP" (proportional uniform percentage) inner valves which are described in the bulletin as having equal percentage characteristics. The bulletin is complete with flow curves. Fisher Governor Co.

Refer to 11-45

Valve Cross-Reference Chart—A new 20-page Valve Cross-Reference Chart has just been issued by this company. Containing 20 pages, the booklet presents a complete listing of the company's valve numbers in order, with their descriptions. It is exceptionally well organized and because of this is unusually easy to use. It should be of great value in helping engineers select the right valve for the right job. The Ohio Injector Co.

Refer to 11-46

Flow Regulating Valves—This 2-page catalog describes the company's new flow regulating valve. Design details are described and pictured to reveal features appropriate for the use of the valve in handling liquids at high pressure drop in

For copies of catalogs use postcard between pages 18-19 and 66-67

connection with drainage and flashing condensate control. The Swartwout Co.

BOILERS

Refer to 11-47

Steam Generator—Fourteen pages are included in this collection of bulletins on steam generators, feed water pump sets. One of the bulletins on the steam generator shows the wide range of fuels, proved efficiency, quick steaming and safety of the unit. Burner controls are described and table of ratings and dimensions is published. The feed water pump sets are for use with the steam generator; tabular material, equipment and specifications are outlined, construction details are given, and operation is described. Cyclotherm Corp.

Refer to 11-48

Automatic Boilers—Here are two bulletins which describe the company's line of automatic boilers from 3½ hp to 200 hp, pressure from 100 to 150 psi. One of the bulletins is completely devoted to a description of a new line—the Model A—which is available in sizes from 3½ hp to 7½ hp. Each of the bulletins is well illustrated and contains tabular information on specifications, dimensions. Construction of the boilers is well brought out in the many sectional illustrations. Steamaster Automatic Boiler Co.

INSTRUMENTS, CONTROLS

Refer to 11-49

Time-Cycle Controllers—A new 12-page bulletin, No. C305, has just been issued by this company covering its new line of Model C500 Impulse-Sequence Time Cycle Controllers. The bulletin gives detailed information about the controller for use in general process applications. The booklet is liberally illustrated with line drawings to show principle of operation and method of use on typical plant processes. The Bristol Co.

Refer to 11-50

pH Meters and Electrodes—Two bulletins —170 and 86-C—have been issued by this company; the first describes its pH meter and the second pH electrodes and accessory equipment. Bulletin 170 gives a complete and detailed description of the instrument and its operation and presents a price list of replacement parts. Price lists and short descriptions of the electrodes and their uses are given in Bulletin 86-C. National Technical Laboratories.

Refer to 11-51

Dimensioned Drawings Handbook—For the first time, this company has combined into a single bulletin a complete set of certified dimensioned drawings covering every available combination of its Flowrator instruments. The book is devoid of all sales information in an effort to condense, into the handiest possible form, comprehensive and accurate dimensional information so important to piping layout draftsmen and designers. Fischer & Porter Co.

PIPING

Refer to 11-52

Expansion Joints—Bulletin 35-30D, eight pages, describe the company's internally guided expansion joint for steam, water, oil and other pipe lines. The bulletin gives complete details of construction, dimensions and also lists prices of various sizes from 1¼ in. to 20 in. in single and double joints. American District Steam Co.

Refer to 11-53

Piping System Color Codes—"Color Identification of Piping Systems," is the title of a recently-issued 8-page bulletin; this bulletin is accompanied by a 4-page folder with a condensed table of color identification and actual color samples of the company's enamel. The first part of the large bulletin covers the reasons for a color code, tells about various codes. A full-page table gives classification of materials carried in pipes. Object and Scope, Definitions, Methods of Identification, Main Classification by Color, Detailed Instructions for Working Out a Standard Identification Scheme and Identification Markings are other sections in the bulletin. American-Marietta Co.

GASKETS, PACKING

Refer to 11-54

Gaskets—Catalog 47 is a 64-page, spiral-bound, general catalog of this company's line of gaskets, sheet packing, washers and metal stampings. The bulletin first conducts the reader through the entire manufacturing process. Next it presents a standard gasket selector on which the various types of gaskets are illustrated; this section is of assistance in fitting the right material to the right job. Tables give sizing information on gaskets. A large part of the booklet is given over to engineering data which consist of tables of circumferences and areas of circles, Centigrade and Fahrenheit conversion tables, decimal equivalents, steam tables, comparative properties of synthetic rubbers compared with natural rubbers. Melrath Supply & Gasket Co., Inc.

Refer to 11-55

Packings Bulletin—This 4-page bulletin describes and illustrates several types of the company's mechanically floating packing. Among the types described are: inside split-case packing, inside cut packing, split flange, marine packing and cups and flanges. Each of these types is well illustrated. Information on how to order metal packing is included. Harper Packing Co., Inc.

Refer to 11-56

Packings Folder—Palmetto Pyramid packing is described and illustrated in this 4-page folder. The description points out the reasons for the excellent design and construction of the various types of packing and also gives recommendations for service. Greene, Tweed & Co.

Refer to 11-57

Packings Catalog—Describing and illustrating the complete line of the company's packings is the purpose of this recently-issued 16-page condensed catalog. Many tables of weights and sizes are included in the booklet and service recommendations are given for each type of packing. An exceptionally useful section of the booklet is a recommendation chart showing the style numbers of packings recommended for practically every type of service. Asbestos Packing & Textile Div., Raybestos-Manhattan, Inc.

TOOLS

Refer to 11-58

Wrenches—Catalog No. 247, 36 pages, describes this company's socket, open end and box type wrenches, specialties and service tools. The front part of the catalog presents a quick reference guide and a numerical index. Each item is well illustrated and described and sizes are given for nearly every item in the line. Blackhawk Mfg. Co.

Refer to 11-59

Tools, Machines—Flexible shaft machines and tools are described in this 20-page folder, a condensed catalog which covers not only the flexible shaft motive power machines but also presents details of accessories and tools for use with them. Condensed specifications and descriptions are given as are list prices. Each item described also is illustrated. Wyzenbeek & Staff, Inc.

Refer to 11-60

All-Purpose Electric Tool—This company's recently announced all-purpose electric impact tool is described in this 4-page folder. The bulletin points out that the tool, using standard attachments, will apply and remove nuts, drill, ream, tap-drive, and remove screws, drive and remove studs, extract broken cap screws and studs, run wire brushes, do hole saw work, drill brick and masonry and drive wood augers. Ingersoll-Rand.

Refer to 11-61

Tools Catalog—Wrenches, pipe cutters, tubing cutters, pipe vises, vises, saw vises and other tools are described in this 16-page catalog. Each of the tools is described in detail and tables of sizes and prices are included. Other price lists are given for tool parts. The booklet is bound in a heavy paper cover. Trimount Mfg. Co.

Refer to 11-62

Masonry Saws—An 8-page folder describes this company's masonry saws. Described is a newly designed product. The saw is pictured completely assembled and smaller illustrations show parts of the unit. A check list of features tells about the absolute elimination of free dust, the self-priming water pump and other advantages of the saw. A 5-day free trial offer is also outlined in the bulletin. Descriptions of the blades which are used in the saw are included and excerpts from testimonials are given. Champion Mfg. Co.

LUBRICATION

Refer to 11-63

Centralized Lubrication—"Studies in Centralized Lubrication," is the title of this recently-issued 8-page bulletin. Stories of achievements made and money saved in individual installations are presented on each page. A typical heading reads, "Savings of $1910.00 a month from $7500 invested . . ." The booklet is well illustrated and examples are clearly outlined. The Farval Corp.

Refer to 11-64

Specialized Industrial Lubricants—Water repellent qualities of these lubricants combined with their high film strength at low viscosity are shown, in this booklet, to be two outstanding reasons for the successful application of these lubricants to all types of industrial machinery. Examples of the use of various of these specialized lubricants for such equipment as hydraulic systems, for open gears, enclosed gears, flexible couplings, for wire rope, worm drives, etc., are presented in brief form. Two pages of descriptions which show how the company's "know-how" has solved many an industrial problem is another feature of the bulletin. The Brooks Oil Co.

MISCELLANEOUS

Refer to 11-65

Metal Hose Booklet—Catalog No. 100, 12 pages, describes the company's line of flexible metal hose. Six different types of hose are shown and the text of the booklet presents such data as ordering information, tables of test results and descriptions of fittings for the hose. Atlantic Metal Hose Co.

Refer to 11-66

Power Plant Profits—"Dividends from Your Power Plant" is the title of this booklet; it contains 36 pages and is bound in a separate heavy paper cover. The various chapter headings will give a clue to the contents; some of these are: "Good" Boilers Can Waste Money. The Engineer is a Gold Mine; The Ideal Boiler of Moderate Size; If Steam Were a Raw Material; If the Production Budget Has a Close Margin. The text is emphasized by carefully selected tables and line drawings. Preferred Utilities Co., Inc.

Refer to 11-67

Industrial Fan Systems—"Fan Systems for Various Industries," is the title of this 32-page bulletin. It describes and illustrates typical examples of blower systems for woodworking industries, dust collecting systems in metal industries, cooling systems for the glass industry and industrial ovens. The need for such systems is explained in each instance and the booklet is well filled with excellent photos of installations. The Kirk & Blum Mfg. Co.

Refer to 11-68

Refrigeration Handbook—Bulletin 80-B is a 36-page Data and Handbook of refrigerating practice and a catalog of the manufacturer's equipment. Titles of some of the sections indicate the scope of the book: Principles of Refrigeration; Ice Making Systems; Low Pressure Refrigerating Units; Air Conditioning Systems; Refrigerated Food Lockers; Quick-Freezing Systems, etc. Tables are also included. The equipment described also covers a wide range of types and capacities, from combined ammonia units and Freon-12 and ammonia booster compressors to large four-cylinder compressors and control equipment and valves and fittings. The booklet, throughout, is exceptionally well illustrated and the material is arranged well for easy reference. Frick Co.

Refer to 11-69

Water Cooler—Described in this new folder is a recently-announced electric water cooler. The bulletin points out some of the unit's features, such as its low operating cost and dependable service and gives complete descriptions of its capacity, cabinet, fittings, lubrication, cooling unit, condensing unit, plumbing connections. A bubbler capacity table gives information on the amount of 50 F drinking water available per hour with varying degrees of inlet water temperature and room temperatures. Oasis Cooler Div., The Ebco Manufacturing Co.

For copies of catalogs use postcard between pages 18-19 and 66-67

New Products and Methods

When additional information on any of the new equipment items described on this or following pages is needed use the postcards which appear between pages 18 and 19 and 66 and 67. Please fill these in completely; the information is needed by the manufacturers issuing the information if they are to promptly comply with your request. No postage is required.

Refer to 11-100

Magnesium Dock Boards

These new dock boards, described as strong, durable and safe, are made of aluminum. They weigh about one-fourth the amount that steel dock boards the same size would weigh. The boards are said to be engineered like a bridge to bear extremely heavy axle loads of material handling equipment such as fork trucks, platform lift trucks and hand trucks. Furthermore they are designed to stay in place and the safety stringers on the sides prevent run-offs. All sizes of the boards are available . . . they are made to fit any truck or railroad car loading or unloading operation. Magnesium Co. of America announces these new dock boards.

Refer to 11-101

Pulsing Drive

The pulsing drive is a new device for controlling electrical motors when accurate positioning is important. It responds to the operation of a single knob. When this knob is rotated in one direction, the pulsing drive closes selectively one of two circuits for very short periods of time repeated at a rate dependent upon the speed of the knob rotation.

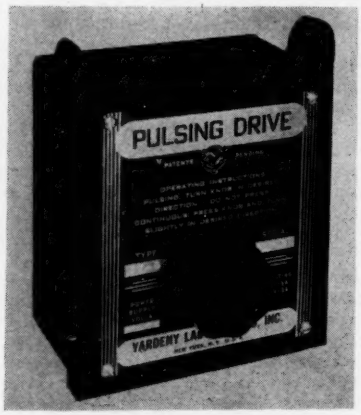
A slow, clockwise rotation of the control knob causes a series of short electrical pulses to be applied to the motor-winding, corresponding to the desired direction of rotation, and results in a corresponding motor motion in small increments. Slow counter-clockwise rotation of the knob causes reverse motor rotation in small increments.

The time period—basic pulse duration—is easily adjustable within a wide range to suit local conditions so that a motor-driven load can be very accurately positioned.

When the rate of pulsation increases, due to faster knob rotation, a point is soon reached at which the pulses overlap so that the switching circuit is kept closed as long as the knob is rotated at that speed, resulting in faster—more extended—travel of the motor.

Provision is also made for continuous contact, when continuous rotation of the motor at full speed in either direction is desired.

The pulsing drive is described as



ideally suited for controlling all standard types of electric motors or magnetic valves.

The direction and extent of motor rotation are under complete control of the single knob and the motor may be rotated continuously for fast travel, or moved in very small increments for accurate positioning. It is announced by Yardeny Laboratories, Inc.

Refer to 11-102

Portable Cable Reel

McColpin-Christie Corp. has announced the development of a new type, self feeding cable reel for handling heavy cables. This reel is particularly suited for the extension of power outlets.

According to the manufacturer, a guide arm on the reel automatically feeds the cable in even layers, greatly facilitating handling. The weather protected feed mechanism adjusts itself to any size cable. The reel will handle up to 325 feet of 1⅝ in. diameter cable (approximately 700 lb) or correspondingly more of smaller size cables. For example, a four-conductor cable of No. 2 wire size can be conveniently handled.

A female receptacle (protected from the weather) is mounted in the hub of the reel, a male plug is attached to the free end of the cable. Cable need be unreeled only as far as required to reach the load, then

Refer to 11-103

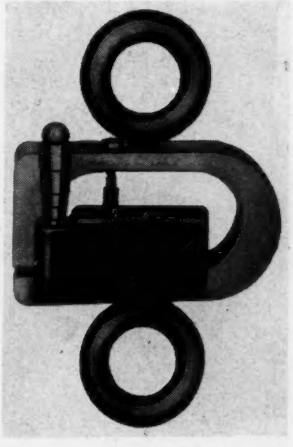
Smart Switch Weighs, Warns

A versatile "monitor" which weighs loads up to 10,000 lb, flashes caution signal, rings bell, and cuts out the hoist motor on chain or cable hoist, and overhead cranes, is the new W. C. Dillon & Co., Inc., Dyna-Switch.

Made of special alloy tool steel, it can be attached between overhead rail and hoist, or between hoist chain and hook in a few minutes. On cranes it is placed directly on hook.

After millions of stress cycles in tests, it always returns to true zero. It withstands accidental overloads far in excess of the limit called for by hoist or crane without affecting calibration.

The Dyna-Switch is made in the Basic model (illustrated), with motor cutoff; Visual model, with red caution lamp; and Weight model, in seven types:

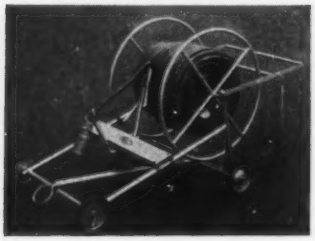


from 0-100 lb to 0-10,000 lb, with indicators showing 1 to 100 lb divisions.

The switch is 7⅞ in. from top to bottom of eye bolts, weighs 3¼ lb. Switch is Burgess Micro-Switch type.

the load plug is inserted into the receptacle mounted in the hub.

Four sturdy wheels and cart make the reel easily portable. Two wheels of the highest grade roller bearing type carry the bulk of the weight. An extendable towing bar with loop is provided which lifts the two guide wheels off the ground when towing. A bar handle conveniently mounted on the cart is used for pulling the



unit. When lowered it also acts as a drag on the drum to prevent overrunning which might cause slack in the cable. The cart is equipped with a foot operated brake to prevent sliding.

In addition to its use for extending electrical power outlets, the reel is also well adapted for reeling hose, flexible tubing, heavy rope, etc.

Refer to 11-104

Steel Factory Sash

Hope's Lok'd Bar Steel Factory Sash are designed for greater strength and weather-tightness in industrial buildings having large glazed wall

areas, and for longer life under conditions of exposure and corrosion, as in chemical process plants, food industries, wherever there are special requirements for sanitation or weather-tightness, and in industrial areas that create difficult conditions for maintenance.

Vertical sash bars are bulb tee sections approaching the I-beam type of section in strength. In the "Lok'd Bar" joint, the flat tee horizontal muntin is threaded thru the bulb tee, both with the least distortion of the metal and the least detraction from solid bar strength. The weight of the section is heavier and the strength of the joint is demonstrated to be double that of conventional sash.

Ventilators are complete casement and frame units, solid welded at corners, reinforcing the sash where they occur. Ventilator sections are rolled in one piece with the weathering flanges integral, avoiding the applied weather construction which invites corrosion. Air infiltration is less than 1 cfm air at 25 mph wind pressure.

Ventilators, when projected, are hung on heavy steel side arms pivoted to the frame at the jambs; when pivoted, they are pivoted on pairs of solid bronze cup pivots. Hope's Lok'd Bar Factory Sash are Bonderized and finished with baked-on coat of rust inhibiting primer. Standard sizes are carried in warehouse stocks and custom-built windows are shipped from the factory. These steel windows are manufactured by Hope's Windows, Inc.

Refer to 11-105

Companion Cleaners for Industrial Maintenance

A new Tornado all-purpose floor machine is now available for plant maintenance which can be used alone for many purposes, but is recommended in combination with the Tornado Industrial Vacuum Cleaner for safe, quick floor conditioning and cleansing at a considerable saving of time and labor. It is announced by Breuer Electric Mfg. Co.

The new floor machine is a powerful motor-driven floor brush capable of performing all types of floor work —scrubbing, polishing, waxing, sanding, steel-wooling, shampooing, etc. It can be used on any type of floor or floor covering with an interchange of suitable brushes and may be equipped with a solution tank which feeds directly into the base of the bristles. Five models are in production, ranging from ¼ hp to 1 hp with operating brush spreads from 12 in. to 20 in. All models have completely enclosed gears in cast aluminum housings and are equipped with sturdy, dependable splash proof, continuous load motors. Each model is exceptionally quiet and easily handled, perfectly balanced, and with the correct weight and pressure to clean thoroughly and effectively.

When used as a companion with the Tornado Industrial Vacuum Cleaner, this effective combination does a quick and most satisfactory job of floor maintenance. The Tornado Vacuum Cleaner has an extremely powerful suction with a 49 in. water lift which instantly picks up surplus water and all moist scraps, deposits them in the 12 gallon tank and dries the floor so thoroughly that it can be used almost instantly in perfect safety without danger of slipping, according to the announcement.

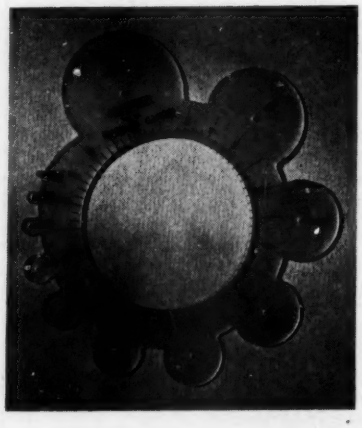
Refer to 11-106

Radius Guide

Rapidesign, Inc., offers the Radius Guide No. 75 to all draftsmen, engineers, etc., for the quick and easy delineation of radii.

The Radius Guide eliminates the time consuming method of finding the correct center with a compass by the trial and error system.

The No. 75 is made from transparent drafting quality 0.030 plastic sheets. All edges are clean cut and smooth. Calibrations and numerals are imprinted. Diameter of instrument is 4½ in.



Refer to 11-107

Lampholders

Specially designed to meet all specifications of the Certified Lamp Makers program, a new line of the "Trigger Ring" lampholders has been announced by General Electric Co.

Among innovations in the new lampholders is a re-designed trigger which provides for selection of "Hi" while in an up position, "Lo" while in the bottom position, and "Off," while in the center position of the switch handle.

Rings on the new lampholder automatically center the lamp in the husk and in the glass bowl assembly and prevent lateral motion of the lampholder itself.

Husk temperatures have been reduced from 40 to 25 F by introduction of a ventilated lamp shell. Insulated with G-E Mycalex, the new switch is designed to stand at least 10 years' normal service, it is said by the manufacturer.

Serving to fasten the lampholder securely in place, the switch nozzle has been equipped with a knurled mounting ring to facilitate quick and economical assembly. Open spaces in the husk have been avoided by inserting the nozzle through a correctly sized round opening.

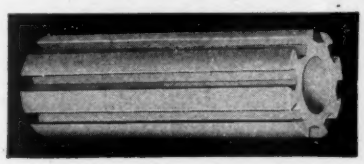
Since no hickey is necessary in installing these lampholders, the inconvenience of inserting long mounting screws and the possibility of damage to wires through twisting in locating the switch handle in the husk's slot have been avoided.

Refer to 11-108

Universal Ceramic Coil Form

Described as eliminating the need for special holes to take leads or mount terminals, a new ceramic coil form comes pretty close to being a universal or stock item. This fluted coil form, developed and now made by Henry L. Crowley & Co., Inc. features dovetail grooves taking either the top lead from any part of the winding and passing it down under the turns to either end, or taking a spring clip which slides along the form to any point where it is cemented firmly in place to act as a terminal or tap connection.

Instead of ordering special coil forms with certain holes for taps and terminals, the coil winder can now stock these new universal coil forms in desired diameters and lengths, yet taking any taps or terminals desired. Also, by means of a simple metal base with turned-up prongs fitting snugly into the ends of the grooves, the coil form can be simply mounted in place. Made of steatite, this coil form provides low-loss performance and maximum stability regardless of temperature and humidity. For iron core tuning, a cap can be snapped over the end of the form and tapped in the center to hold the core screw for adjusting the core position relative to the windings.



This fluted coil form is also applicable to wire-wound resistors either as the supporting core or again as the cover for high-wattage resistors, for better heat dissipation. The channels or grooves can be used to insert printed or colored tabs for identification such as part number, color code or other markings.

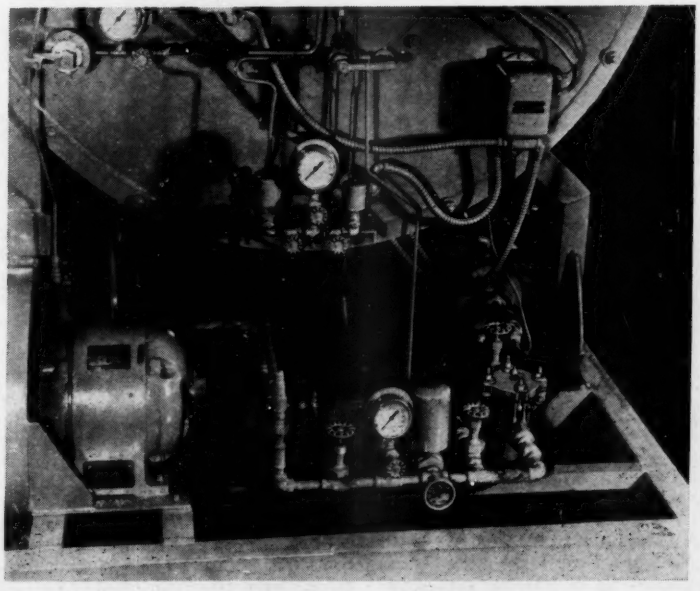
Refer to 11-109

Strainers Increase Pump Life and Steam Generator Efficiency

A manufacturer of steam generators, Ames Iron Works, Oswego, N. Y., protected the performance of its product by installing two strainers (made by J. A. Zurn Mfg. Co.) whose primary functions are to protect the fuel oil pump and burner tips of the unit. With each generator for heavy oil firing, a coarse mesh duplex strainer is installed on the suction side of the fuel oil pump. As heavy oil contains large quantities of entrainment, the strainer reduces wear on the gears and casing of the pump and eliminates the possibility of a pump breakdown which would halt operation of the generator. As continuous operation is important in this unit, the strainer has two chambers. The flow can be directed from one chamber to the other without interrupting operation. The idle chamber can then be opened, the strainer basket removed, cleaned and replaced.

A fine mesh single basket strainer is placed between the fuel oil pump on the outlet side and the burner tip. This strainer, in addition to the other, removes practically all foreign particles before the flow reaches the burner tip. This keeps the generator operating efficiently by preventing impurities from clogging the nozzle.

Many designers of equipment and machinery requiring an oil circulatory system may find similar uses for properly designed strainers. Frequently the small cost of strainer protection avoids a breakdown of a pump which in turn would shut down the equipment on which the pump was operating. A breakdown of equipment in an industrial plant may mean the loss of hundreds of dollars in time.



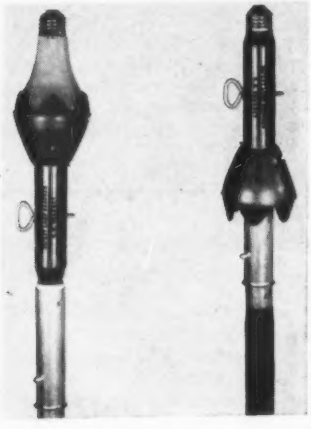
New Products and Methods

Refer to 11-110

Lamp and Base Changer

A safe, convenient method of changing electric light lamps and removing broken bases is provided by the Chadsey Safety Lamp Changer and Broken Base Remover. It consists of a changer head of heavy gage synthetic rubber, impervious to oil, kiln dried wooden sectional poles, stained and waxed against moisture, fitted with heavy brass couplings, and an adapter connecting the head and the poles.

The device, designed to eliminate entirely the hazard of falls, shocks or burns, operates by sliding and twisting the changer head over the



lamp to be replaced or removed. The changer head acts "like the grip of the hand." Lamps from 10 watts to 1500 watts can be handled by these changer heads. Sectional poles in 4-ft and 6-ft lengths can be fitted together like a casting rod to reach any desired height.

An exclusive feature of the lamp changer is its ability to remove broken bases. By reversing the changer head on the adapter, the tapered end fits inside the broken lamp base and is twisted out by friction. The lamp changer, approved by safety engineers, is tested to withstand 29,000 v. It is made by C. R. Chadsey Mfg. Co., Inc.

Refer to 11-111

Lightning Discourager

Each year lightning is the cause of more than 34,000 fires. More than $10,000,000 is lost to industry and more than 1,500 people killed or injured. Manufacturers working with the National Fire Prevention Asso., are constantly developing anti-lightning equipment in an attempt to whittle the casualty list and property damage costs to the bone. One of the more recent protective measures is the clay vent cap designed by the Robinson Clay Product Co. to slip over any bare vent or stack. Clay is a non-conductor and discourages the attack by lightning. Particularly

adaptable to chemical plants, or manufacturing plants where acid fumes are being discharged via vents or stacks. Clay is resistant to acids and will thus resist deterioration due to acid bearing fumes.

Refer to 11-112

Hard-Facing Method

A new method for hard-facing by using a metallizing gun and Metco-Weld H, a "wire" composed of a powdered hard-facing alloy extruded with a plastic binder, is announced by Metallizing Engineering Co., Inc.

This Sprayweld method attains the previously difficult objective of applying smooth, uniform, relatively thin hard coatings, in a highly practical and inexpensive manner.

During the spraying operation, the plastic binder is completely volatilized, and the deposit consists entirely of the metallic constituent. Subsequent fusing, with any fusing torch or with an attachment on a Metco metallizing gun, results in a coating alloyed to the base and physically and chemically identical to hard-facings of the same alloy applied by other methods.

The alloy used in Metco-Weld H is reported to be uniue. It possesses excellent resistance to abrasion—will outwear hardened steel 3 to 10 times for this type of service. It resists corrosion better than stainless steel under most of the conditions for which stainless is generally used. It combines a low melting point with a long range of plasticity (1850 to 2050 F). It has high strength at red heat and exceptional resistance to oxidation.

Bulletin 53 explaining the operation and advantages of the Sprayweld process is available upon request.

Refer to 11-113

Grinding Wheel

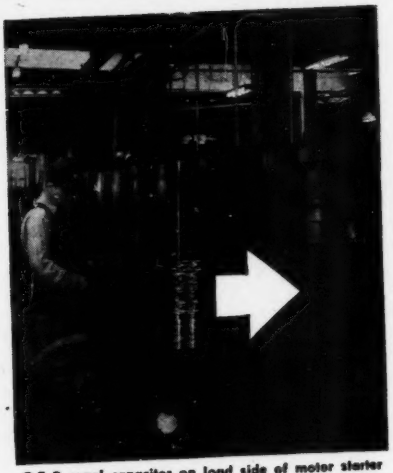
The Carborundum Co. has announced a new grinding wheel known as "Series 20". This new product is a completely new type of ceramic or vitrified bonded grinding wheel in which a new type of abrasive grain is used, and constitutes a progressive step in modern abrasive engineering development. In this new wheel factors tending to interfere with cutting action have been reduced and those contributing to higher cutting efficiency have been increased. The new wheel is designed for better performance in the tool room, particularly in general tool and cutter grinding, surface grinding and surface and cylindrical grinding of forms and, also, for production grinding operations. The use of this wheel, it is said, assures faster stock removal, less grinding hours, fewer damaged tools, less heat concentration, better finishes.

Refer to 11-114

Clevis Hook

Featuring unusual speed of attachment and maximum safety, a newly developed clevis hook has been added to a most complete line of drop-forged wire rope and chain fittings now offered to industry by the Thomas Laughlin Co. The clevis design, utilizing a bolt, slotted nut and cotter pin for fastening, makes it easy to attach the hook and switch from one job to another, yet meet all safety requirements. No welding, machining or threading are necessary to attach this hook.

The Laughlin Clevis Hook can be supplied with the Laughlin Safety latch, or with reversed jaw, on spe-



G-E Pyranol capacitor on load side of motor starter at Union Wire Rope Company

How Kansas City Firm BOOSTED FEEDER CAPACITY 31% without installing new copper

The Union Wire Rope Corporation of Kansas City, Mo., needed to install more machinery to increase production. The plant's 2600-kva of transformers and feeders were fully loaded. But—a lot of the load was in kilovars (reactive kva) used by induction motors on the circuits.

Producing Kilovars at Motors Was the Answer

So Union, rather than replace feeders, began to install G-E capacitors. These are connected to motor starters—produce the needed kilovars on the spot, for each individual motor. Installation has been gradual—a 5-kvar capacitor here, a 10-kvar unit there—until today 1245 kilovars are supplied right at the motors. Relieved of this non-productive load, the original feeders are delivering almost a third more power, to additional machines.

New Motors, Too, Will Have Capacitors

While power factor at Union is now good (95 per cent against the original 68) each new motor will have a capacitor installed with it. It pays—in reduced size of new feeders, transformers, and switching equipment, in better motor voltage, and in lower distribution losses.

CAPACITORS MAY MAKE SIMILAR SAVINGS FOR YOU

If you need additional power from fully loaded circuits or transformers, investigate capacitors. If you are having troubles because of low voltages, capacitors may be your answer. And, if you have a penalty clause in your power contract—power factor, kva demand, or kilovar—capacitors will almost certainly save you money.

In any of these cases, a General Electric engineer will be glad to work with you in determining how capacitors can help you, and just how much they will save. Just call your G-E representative, or write *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

Recommended maximum rating (in kvar) for capacitor connected to load side of induction-motor starters.

MOTOR RPM	INDUCTION MOTOR HORSEPOWER RATING												
	10	15	20	25	30	40	50	60	75	100	125	150	200
3600	2.5	2.5	5	5	7.5	10	12.5	15	17.5	22.5	25	32.5	42.5
1800	4	5	5	7.5	10	10	12.5	15	17.5	22.5	27.5	35	42.5
1200	4	5	5	7.5	10	10	12.5	15	17.5	22.5	27.5	35	42.5
900	5	7.5	7.5	10	10	12.5	15	17.5	20	25	30	37.5	45
720	5	7.5	10	10	12.5	15	20	22.5	27.5	35	40	47.5	60
600	7.5	10	12.5	15	15	17.5	22.5	25	30	37.5	47.5	55	67.5

GENERAL ELECTRIC

407-136

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cial order. It is made in four of the most popular hook sizes, 1½, 2, 3 and 5 tons, and all parts, including bolts, are of drop-forged, heat-treated steel.

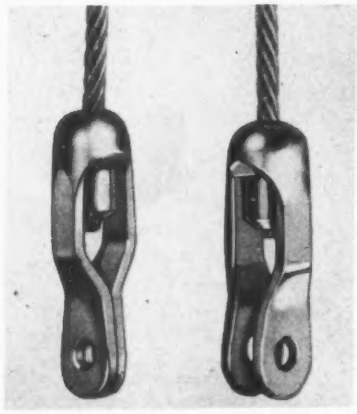
Refer to 11-115

Socketype Cable Terminals

Macwhyte Co. is now making the "Socketype Cable Terminals" formerly made by Paulsen & Nardon, Inc., of Los Angeles.

These terminals consist of an alloy steel cadmium plated eye or fork type fitting, plus a stainless steel sleeve for swaging to cable (wire rope). They are available loose or attached to the rope in a complete cable assembly to specification length.

Formerly known as the PN socket



type cable terminals, they are now called "Macwhyte Socketype Cable Terminals." Literature says that they have been approved by the Civil Aeronautics Administration for use at 100 per cent of the rated strength of the cable to which they are properly attached. Further, it is said that these terminals save cable, allow the cable to swivel freely when load-free which eliminates kinking. They provide a safe, smooth, foul-free installation.

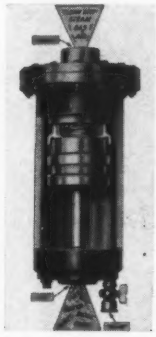
Refer to 11-116

Textile Air Separators

The Chicago Manufacturing & Distributing Co. announces the new Model "E" Air Separator for delivering clean, dry steam, gas and air.

There are no moving parts—screens—filters, felt or wool. No adjustments or regulations are necessary. CMD Model "E" Separators are strictly mechanical in operation and require no attention whatsoever other than draining off condensate that accumulates in the chamber. Non-corrosive metals are used throughout the separator. The Model "E" has a maximum rated capacity of 250 cfm and the following dimensions: 8 in. diameter, 15 in. high, having 1½ in. standard pipe connection.

The company also manufactures



three other models for lower-rated operating capacities.

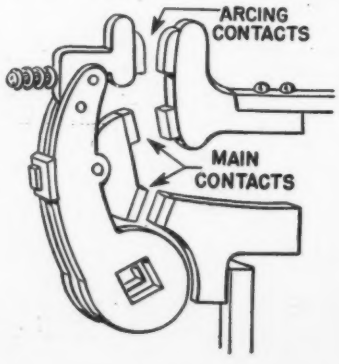
The company has developed several tables as well as technical information and bulletins required for the correct operation of separators, as well as correct pipe and air required, and a table indicating the correct size of separator required for any given diameter of orifice discharge of compressed air per minute.

Refer to 11-117

Electrical Contacts

Silver-molybdenum electrical contacts said to possess excellent arc resisting characteristics are now being manufactured by Gibson Electric Co.

At present, the new contact material is supplied in two grades: Gibsiloy M-10 and Gibsiloy M-12, the latter containing a higher percentage of molybdenum. Because of its higher refractory content, Gibsiloy M-12 is used on heavy circuit breakers where greater mechanical and electrical stresses are encountered. Gibsiloy M-10 is used on smaller size circuit breakers handling lower pressures. Gibsiloy silver-molybdenum electrical contacts are suitable for use as arcing tips in either air circuit breakers



or oil circuit breakers, also as contacts in other oil immersed apparatus such as transformer tap changers.

Made by the powder metallurgy process, Gibsiloy silver-molybdenum contacts combine high hardness with good conductivity. Grade M-10 has a hardness of 75 Rockwell B with 50 per cent of the conductivity of pure silver, and Grade M-12 has a hardness of 85 Rockwell B with 45 per cent conductivity. The high hardness and refractory content of the material result in excellent resistance to wear from both arcing and mechanical action.

Gibsiloy silver-molybdenum electrical contacts are made in individually molded shapes for each application, thereby eliminating expensive machining operations and conserving material. They are furnished solder backed for convenient and dependable brazing.

Refer to 11-118

Roller Pipe Supports

These new roller pipe supports, announced by Unistrut Products Co., are characterized by simplicity and ruggedness. One inch to twelve inch pipe can be supported on the same roller assembly having only the axles vary in length. This standardization greatly reduces the problem of stocking and supplying parts for roller pipe supports to accommodate many

Refer to 11-119

Dismounting Time for Bearings Cut

A more economical and time-saving method of removing large anti-friction bearings from machines—in minutes instead of hours—is now being applied by an increasing number of manufacturers, according to Dr. Haakon Styri, director of research for SKF Industries, Inc.

By pressuring oil from a hand-operated hydraulic pump between the bore of the bearing and the shaft on which it is mounted, Dr. Styri pointed out, the inner ring expands and "floats" on the oil film, enabling the operator to remove the bearing with greater ease and in less time. The method, introduced to industry by the ball and roller bearing firm, is also successful for coupling two shafts together, Dr. Styri said.

The application of oil at 7,000 to 8,000 psi reduces dismounting time to 10 or 15 minutes, he said, as compared with several hours required by the former method involving use of pullers and hydraulic jacks.

WM. W. NUGENT & CO., INC.

WILLIAM W. NUGENT

FOUNDER 1861-1938

1897 *50th Anniversary* 1947

The Wm. W. Nugent & Co., Inc., takes this opportunity, on the occasion of its Fiftieth Anniversary, to express its appreciation for the confidence and loyalty toward Nugent products expressed by an ever increasing acceptance throughout industry. As in the past half-century, it is our continued aim to insure that Nugent products embody only highest quality design, materials and workmanship.

Boliss D. Nugent

President

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New Products and Methods

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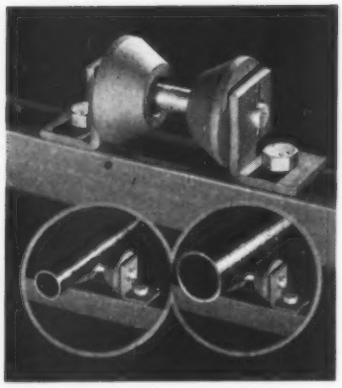


different sizes of pipe. Stocking a number of standard roller assemblies with additional axles of varying lengths provides for maximum flexibility with minimum stock.

Unistrut roller pipe supports mounted on Unistrut framing members is said to eliminate the necessity for conventional screw adjustments. This method of completely adjustable metal framing permits flexibility in the placement of the pipe supports. Alining a pipe run for definite pitch or slope can easily be done by the simple adjustment of the Unistrut framing.

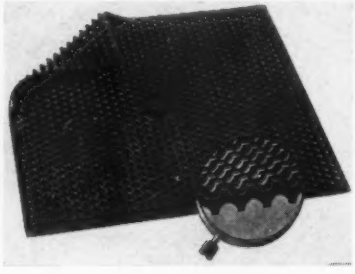
Refer to 11-122

Rubber Mat

"Magic Mat," a new and unique rubber mat for added safety and the elimination of fatigue in the factory has recently been introduced to the market by Avenue Manufacturing and Sales Co.

Consisting of over 2,000 ¼ in. high rubber cones which cushion the feet, this black, non-marking mat is 21¼ in. square. Its overall thickness is 11/16 in. with a center layer thickness of 3/16 in.

Among its many unique features, scientifically designed for use where persons stand on their feet for long periods of time, is its self-cleaning construction, cones on both sides for



longer life and elevation from damp floors to prevent electrical ground shocks.

For industry, it is outstanding for safety because of its non-skid feature and the cutting down of fatigue.

Refer to 11-121

Making Water Wetter

Making water wetter . . . wet enough to sink a duck . . . is a laboratory trick which has now been put to practical use by American - LaFrance - Foamite Corp. Pentrate is the brand name of the compound this company is producing. The company states that 1 per cent of this material when added to water gives the combined solution speedy penetrating and spreading qualities much superior to water itself, therefore much superior to plain water when it comes to fighting fires. When applied to the surface of a deep-seated, smoldering fire it gets to the heart of it in a hurry.

Pentrate is no more injurious to metals or wood than water itself. It has even less corrosive effect than water and can be used effectively with salt water or calcium chloride solutions.

Ordinary water has a surface resistance, as evidenced by rain drops on a window pane, or morning dew which is held in almost perfect globular beads of water. The surface tension holds it from flattening, spreading out, or penetrating freely.

Adding 1 per cent of Pentrate has the effect of freeing the surface tension and allows the globule to spread out in all directions and cover more area.

Pentrate, therefore, makes wetter water by giving the water a better chance to spread, to penetrate, and to soak into an object on fire; to cover more readily broken or rough surfaces; to penetrate deeply into bales of cotton, waste, mattresses, overstuffed furniture, textiles, dry humus, coal piles, etc.

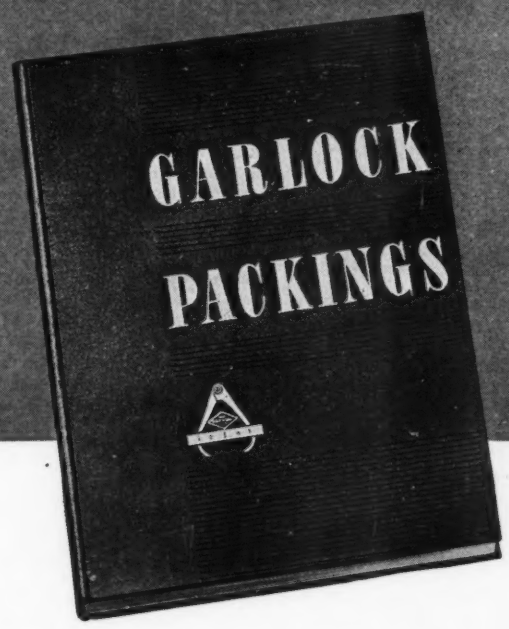
Free illustrated literature about this newest fire-fighting agent is available upon request.

Refer to 11-123

Seamless Flexible Metal Hose

This new seamless flexible metal hose is made of a special alloy seamless bronze tube, fabricated by a revolutionary method. The tube is gently but firmly formed into a uniform helically corrugated, flexible hose, retaining the maximum desirable characteristics of the original tube. It is announced by the Brockway Co.

The flexing quality of metal hose is dependent upon characteristics carefully built into the product, such as form, depth and frequency of corrugations, material and above all, a thorough knowledge of the behaviour



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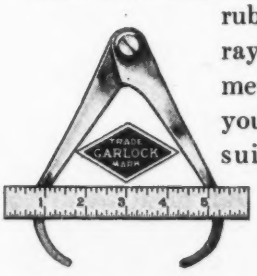
IF YOU BUY or use packings or gaskets you need this new Garlock catalog.

Its 224 pages describe and illustrate packings for high pressures and low pressures—for water, air, steam, acids, solvents, oils and other liquids and gases. So whether you need a packing made of rubber, synthetic rubber, asbestos, cotton, flax, rayon, leather, plastics or metals, this catalog will help you select a Garlock product suitable for your job—a product manufactured in the Garlock factories and measuring up to the highest quality standards which Garlock has rigidly maintained for sixty years.



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New Products and Methods

of the finished product under exacting service conditions.

To give additional safety, extra, valuable life, and prevent elongation, this metal hose is encased in a high-tensile bronze wire braid. This sheath is permanently attached to carefully designed couplings that are built to "stand the gaff" and to relieve the hose itself of damaging strains.

The Uniflex fitting provides metal-

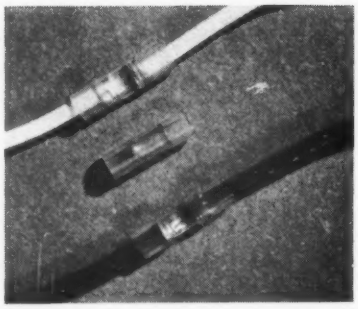
to-metal seat by means of a seal produced between the fitting body and the spring washer effect of the hose, itself. No brazing or packing is required. Once the fitting is assembled it remains permanently leakproof.

The fitting is short, compact and permits the use of more hose length (and less fitting length) thus providing maximum maneuverability.

Refer to 11-124

Pressure Connectors

The Thomas & Betts Co. has recently announced the latest addition to its line of Sta-Kon pressure connectors—the No. 25 insulated splice. It is a seamless bronze connector pro-



tected with a translucent high dielectric plastic insulator that is impervious to oil, grease, water, chemicals and acids. The insulator is bonded to the connector and can not slip or become accidently detached. A perfect connection is easily obtained with Standard T&B Sta-Kon hand or power operated tools. The new splice is unique in that a single squeeze of the installing tool permanently connects both wires and insulates the connection.

Refer to 11-126

Vibration Control Unit

A new low-cost vibration control unit, the Korfund Type RS Conical Rubber-Spring Mounting, has been announced by The Korfund Co., Inc.

The Type RS has a high load ca-

pacity, ranging from 25 to 125 lb per unit. The conical spring design provides greater horizontal stability than conventional all-rubber mountings. This means smoother operation, particularly during starting, and frequently eliminates the necessity for snubbers or flexible connections.

This combined use of rubber and steel springs not only increases the load capacity but also gives the Type RS a wide frequency range for successful isolation. It is equally effective for pumps operating at 1750 rpm, as well as compressors running at 450 rpm.

The new unit has been designed primarily for use on compressor units, generator sets, motor generators, pumps, motors, fans and other machinery requiring a highly efficient, economical, standardized vibration isolator.

Refer to 11-127

Miter Gear Box

This ruggedly constructed Miter Gear Box is made with a solid mounting base to simplify installation, and it may be installed in any position.

Precision miter gears assure dependable operation for medium speed power drives or hand operation with 1:1 ratio. The steel cut gears meet power and torque rating for each respective shaft diameter in conformance with the engineering standards of AGMA. Furnished with bronze or roller bearings, as required.

The hydraulic type grease fittings provide positive lubrication of the bearings. Oil seals prevent leakage thereby maintaining proper oil level for lubrication of gears. Steel shafts are firmly keyed to the gears. Six sizes are available with ½ in. to 1¾ in. shaft diameters.

Used in the operating controls of valves, doors, steering gears and other mechanical devices and power drives of transmission equipment. It is announced by Piezo Mfg. Corp.

Refer to 11-125

Temperature Measuring

Fairchild Camera and Instrument Corp. has announced a new pneumatic temperature measuring system for measurement and control of extremely high gas temperatures to 5,000 deg, Reaumur. The instrument is a form of gas thermometer utilizing the density of the gas being measured as a direct indication of the temperature.

The Fairchild corporation claims this method can solve specific measurement-control problems encountered in a broad variety of fields, including aircraft, marine, railway, and general industrial. Instruments are also available for laboratory use.

The new system is not subject to the usual radiation effects common to present temperature sensing methods. It can be applied for temperature measurement and control wherever a small quantity of the high temperature gases to be measured or controlled can be continuously sampled.

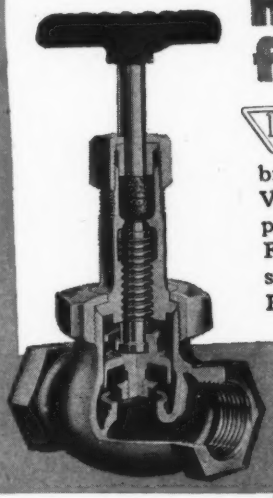
Specified accuracies for these instruments are plus-or-minus 1 per cent to 2,500 deg R., and plus-or-minus 2 per cent from 2,500 to 5,000 deg R., with a response rate of ½-second or less.

Refer to 11-128

Smallest Yet Dynamometer

To measure tension or force in those "tight" spots found in many

high-value highlights of the fairbanks bronze valve line



MANY VALVES FOR MANY SERVICES can be selected from the broad range of Fairbanks Bronze Valves highlighted here. Made for pressures from 125 to 300 pounds, Fairbanks Valves are available with screwed or flanged ends also with Faircoseal ends for Silbraz joints.

The Fairbanks distributor performs **many services for many industries.** Adequate stocks of all types of piping and mill supplies as well as Fairbanks Valves are available as needed, day or night.

Consult your distributor for all valve installation requirements.

Fig. U-01
150 Pound COMPOSITION DISC GLOBE VALVE

Renewable composition disc, slip-on holder, two-piece Union Bonnet. Radial joint assures pressure tightness . . . makes dismantling quick and easy for disc renewal. Has excellent record on oil, gas, steam, water, or air lines where composition discs are suitable.

BRONZE GLOBE AND ANGLE VALVE with Bronze Disc

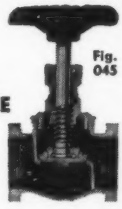


Fig. 045

Screwed-in Bonnet, integral seats. Rugged, compact with exceptional resistance to pressure and pipe strains. For steam, water, gas and oil — 125 lbs steam pressure.

REGRINDING Globe, Angle and Cross

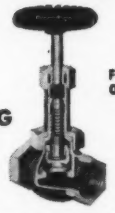


Fig. 033

Bronze disc—integral seat—union bonnet—200 and 300 pound pressures. For higher pressure service where composition discs are not satisfactory

RENEWABLE REGRINDING Globe and Angle

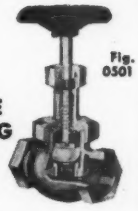


Fig. 0501

Nickel alloy seat and disc—union bonnet—200 and 300 pound pressures. For more severe services on steam, water, oil, gas and air.

PLUG DISC AND SEAT Globe and Angle

Fig. 0501-P

Renewable hardened nickel alloy seat and disc—200 pound pressure. For throttling and other service requiring close regulation of flow.

NON-RISING STEM Gate Valves

Fig. 0250

Screwed bonnet — solid wedge — taper seat 125, 150 and 300 pound pressures. For full flow of steam, water, oil and gas.

RISING STEM Gate Valves

Fig. 0228

Screwed bonnet — split wedge — solid wedge for 125 and 150 pound pressures. For steam, water, oil and gas.

OUTSIDE SCREW AND YOKE Gate Valves

Fig. 0209

Screwed bonnet — solid wedge — taper seat — 150 and 300 pound pressures, where operating threads must not contact fluids.

UNION BONNET Gate Valve

Fig. 0230

Non-rising stem — nickel alloy wedge—integral seat—200 pound pressure. For higher pressures on steam, water, oil and gas.

Fig. 0601

SWING CHECK VALVES

Horizontal—renewable bronze disc—125, 150, 200 and 300 pound pressures. For maximum flow of steam, water, oil and gas.

Fig. 0616

LIFT CHECK VALVES

Horizontal—angle. Renewable composition disc for 150 pounds —regrinding bronze disc for 200 and 300 pounds. To prevent return flow. Positive vertical lift of discs.

American industry flows through

fairbanks valves

For further information, write The Fairbanks Company, 393 Lafayette Street, New York 3, N. Y., or Boston 10, Mass.; Houston 2, Texas; Pittsburgh 22, Pa.; Rome, Ga.

New Products and Methods

types of mechanical assemblies, a miniature dynamometer has been developed that is said to be the smallest of its kind. The case measures 3 in. in diameter; the instrument weighs but 1 lb.

It is available in 100 lb, 250 lb and 500 lb capacities; has an unbreakable lucite crystal and red, maximum hand. The dial is black with etched silver numerals. Components are die cast of Zamac No. 3 alloy.

The company also makes the larger Model AN dynamometer for measuring forces up to 20,000 lb, identical to the small model in every detail but size. A complete catalog will be sent by W. C. Dillon & Co.

Refer to 11-129

Duplex Strainer

A new type duplex or twin sediment strainer has been developed by the J. A. Zurn Mfg. Co. This product was designed to meet the demand for an economical strainer in pipe lines where continuous flow is imperative. When the strainer is to be cleaned, flow can be diverted from one basket to the other without interrupting passage through the strainer. The unit operates by means of a single plug type valve whose orifii direct flow from the inlet to either basket, or both simultaneously. The seating of the plug into the body is regulated by the relieving yoke which acts to seat the plug tightly for sealing, or to loosen it for turning, as required. Plug action is positively non-freezing —operates freely and easily at all times. Dual air relief valves are regularly furnished, available with flanged or screwed connections, and suitable for working pressures from 125 to 300 psi. A basket chamber cover yoke assembly, or C-washer type bolted cover assembly is furnished as required. Both types are quick releasing. Made in bronze, steel, semi-steel, or special alloys to specifications. Sizes 1 in. to 6 in. regularly.

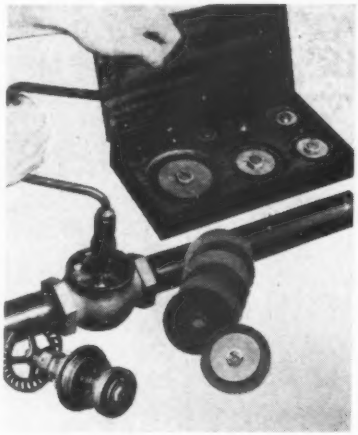
Refer to 11-130

Valve Reseating Tools

The new reseating tool for globe, angle and check valves employs aluminum oxide discs mounted on both sides of a wafer-thin steel body and is so constructed that the tool is operated by means of a brace equipped with screw-driver bit.

Because of its unique construction no special guides or jigs are required and it is not necessary to dismantle the bonnet and stem assembly of valve, therefore, the stem packing is not disturbed.

One side of the pivot tool has a



coarse abrasive disc which enables one to rapidly grind away the seat defects while disc on other side is finer so that by reversing the tool a mirror-like finish can be put on the valve seat.

Pivot valve reseating tools are available in eight sizes for valves from ½ in. to 3 in., inclusive, and are packed in attractive hardwood cases in two sets, the No. 60 set for valves ½ in. to 2 in. and the No. 80 set for valves ½ in. to 3 in. A generous supply of extra abrasives is furnished with each size tool. It is manufactured by Grace Products Co.

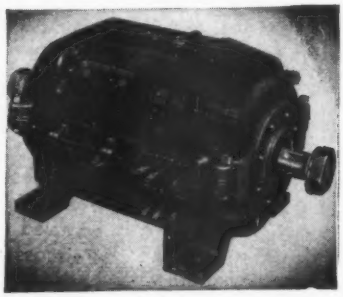
Refer to 11-131

New Mill Motors

A new line of mill motors reduced one frame size is announced by Westinghouse Electric Corp. A larger and more efficient armature that fits within the limiting dimensions of the motor frame, new roller bearings and bearing housing, and redesigned field coils make the new motor possible.

The heavy duty type MC mill motor is available in totally enclosed, protected self-ventilated or protected force-ventilated construction. It is built in accordance with the AISE standardized dimensions and incorporates the following features: split frame of cast steel; silicone insulated armature coil conductors; wedges of Class B material to hold coils in slots; new roller bearing and bearing housing that eliminates need of thrust washer and collars; improved field coil insulation; and rigid mounting of brush holders.

It is available in sizes from 5 to



200 hp; in voltages of 230 and 550; and in AISE dimension frames 602 to 618.

Refer to 11-132

Small Extinguisher

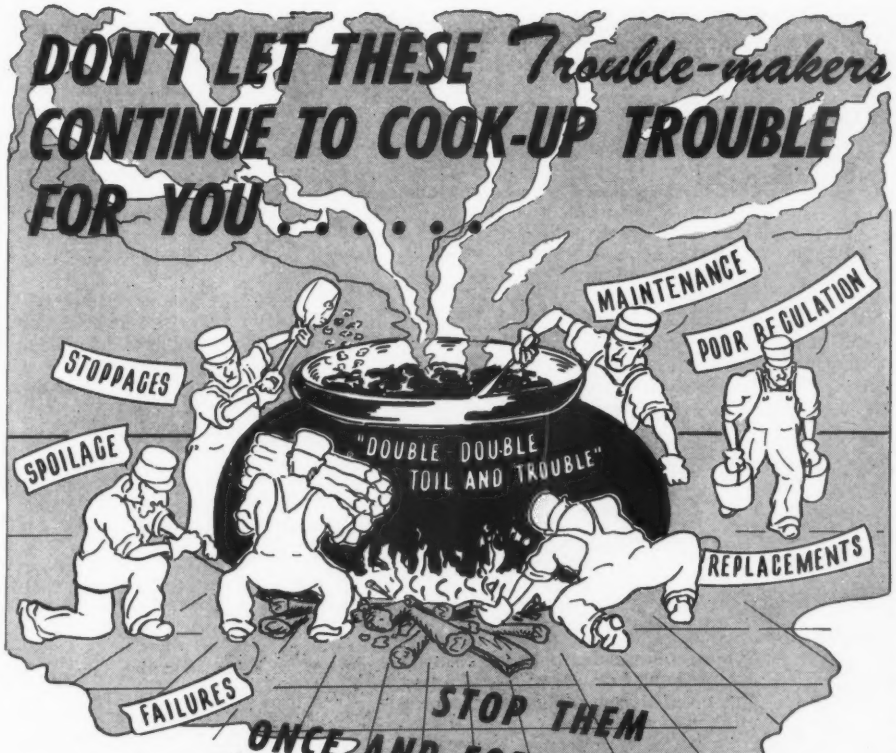
A new extinguisher, small enough to fit anywhere and inexpensive enough to encourage wide use throughout the plant, is said to provide industry with on-the-spot fire protection. It is announced by Power-Pak Products, Inc.

Only 15 in. long by 1⅞ in. in diameter, this unit comes equipped with a wall bracket for placement alongside machines, equipment or materials in danger of electrical, oil, gas or other inflammable liquid fires. Weighing only 2 lb 6 oz filled, including 10 oz of carbon dioxide, Power-Pak is said to be an easy unit to handle.

To operate, one lifts the extinguisher from the bracket, points the nozzle at the base of the fire, turns the handwheel and sweeps the flames away. The dense, dry fog rids the fire of oxygen it is pointed out, instantly smothering the flames. Units are refilled for 75 cents.

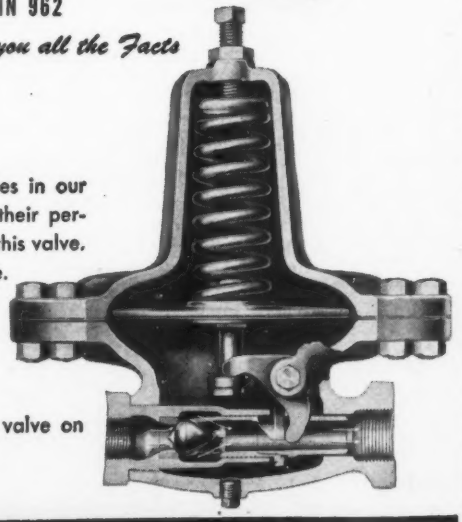
Power-Pak's extinguishing agent is described as perfectly safe. CO_2 is

DON'T LET THESE Trouble-makers CONTINUE TO COOK-UP TROUBLE FOR YOU . . . . .



STOP THEM ONCE AND FOR ALL WITH THE CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000

◀ BULLETIN 962
Gives you all the Facts



A USER SAYS:

"We have had many STREAMLINER Valves in our plant and I am more than pleased with their performance. Since 1938 when we first tried this valve, we have never purchased any other make.

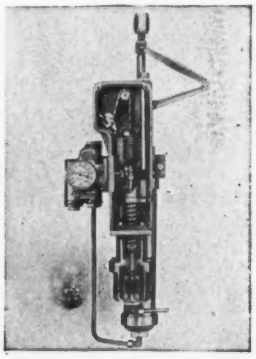
"They are used on steam lines to our yeast tubs, on treating lines, on steam lines to the hot water heaters, and on steam lines in the laboratory.

"In my opinion, this is the best reducing valve on the market."

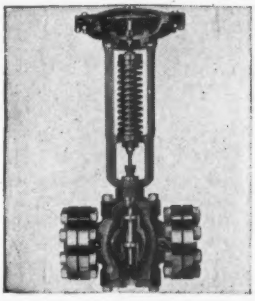
CASH STANDARD CONTROLS . . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

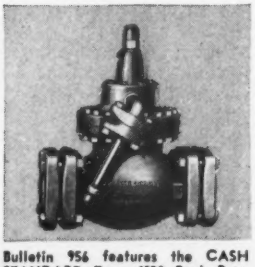
BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES
Send for them



Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

non-toxic, non-asphyxiating and non-conductive. It has absolutely no harmful effects, and eliminates the dangers of poisonous fumes inherent with some agents. In being non-conductive, it is highly dependable for electrical fires. There's no chance of damaging plant interiors, office records, materials, clothing or equipment. Power-Pak is clean and non-staining. In fact CO_2 is even odorless and tasteless.

Refer to 11-133

Motor Repair Parts

Motor repair parts are again available from Wagner Electric Corp. in two handy kits, the small M-1 for service men to carry with them, and the large M-2 for convenience and economy of stocking replacement parts in the shop.

The M-1 container is of heavy fibre,

11¾ in. long, 6 in. wide, and 1¾ in. deep. It contains a variety of 61 replacement parts most commonly needed in repairing appliance type motors up to and including ½ hp, including sleeve bearings, brushes, and switches. Shipping weight is 3 lb.

The M-2 drawer-type container is of sheet steel, 24½ in. long, 13 in. wide, and 4 in. deep. It contains an assortment of almost 700 fast-moving replacement parts for repulsion-start induction and capacitor-start motors up to and including 3 hp. Shipping weight is 46 lb.

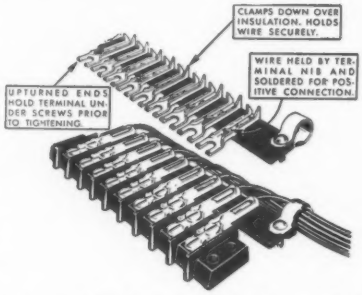
Each kit has a list of contents printed on the inside cover in order to simplify reordering. For detailed information Bulletin MU-34B is available.

Refer to 11-134

Fanning Strip Facilitates Terminal Wiring

An entirely new basic improvement in terminal wiring is announced by Howard B. Jones Division, Cinch Mfg. Corp.—the Jones Fanning Strip. With this new unit, multiple wiring to barrier terminal strips is greatly simplified and facilitated. From one to 20 wires from the cable lead-in can be securely anchored to proper terminals and quickly soldered, without the usual complications.

Connections through the Fanning Strip can be made on a bench or anywhere apart from the mounted barrier strip, and the entire assembly slipped into place in the barrier strip in an instant. All that remains is tightening of the terminal screws, and the assembly is complete.


CLAMPS DOWN OVER INSULATION. HOLDS WIRE SECURELY.
WIRE HELD BY TERMINAL NIB AND SOLDERED FOR POSITIVE CONNECTION.
UPTURNED ENDS HOLD TERMINAL UNDER SCREWS PRIOR TO TIGHTENING.

Assembly is thus greatly speeded up. Time is saved. Incorrect connections are eliminated both in the original assembly and servicing. Correct and positive connections are assured at all times.

Precision engineering, and sturdy construction for longest service are characteristics of the Fanning Strip. Brass terminals are cadmium-plated. They are securely riveted on a heavy bakelite mounting base. Strong cadmium-plated terminals are 1¼ in. Length of the Fanning Strip is determined by the number of terminals used. Other factors are shown in the diagrammatic photograph herewith.

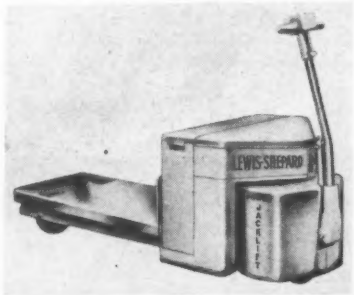
Refer to 11-135

Power Jacklift

Lewis-Shepard Products Inc., announces the addition of a 6000 lb capacity, completely electric, platform model Power JackLift. This hand operated truck retains all of the features of the 4000 lb model.

The JackLift it is said, will increase the quantity of material handled daily and is easily maneuverable in difficult sections of a plant.

The machine is controlled entirely from the handle head and may be operated with the handle vertical or in any other position. No movement of the handle is required to start, stop, change speed, or lift and lower the load. Vertical handle operation is reported to save up to 18 in. in aisle space. Finger tip push button controls in the handle head give a tremendous saving of time where space is restricted and traffic is heavy. In close quarters the operator can maneuver easily and stop safely. Whenever the handle is released, the positive, smooth action "Deadman" type electric braking control insures safety instantaneously.



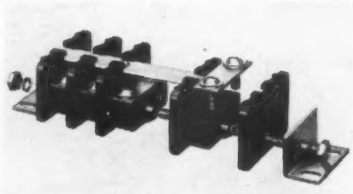
The master drive unit of the Jack-Lift not only comprises modern and reliable mechanism but is actually a separate interchangeable unit which makes possible almost continuous operation of a fleet of trucks by interchanging power units whenever servicing is required.

Refer to 11-136

Build-Up Terminal Block Kit

A new terminal block kit expressly designed for experimental work and maintenance operations was introduced recently by the Curtis Development & Manufacturing Co.

In a bulletin just prepared by this firm, a description of the kit, termed their "Type 'B'," discloses that any



number of terminals, from 1 to 14, can be quickly and inexpensively produced. These terminal blocks are similar to factory built blocks and equally substantial.

This individual "build up" feature is uniquely suited for electrical engineers and others doing experimental work who need "one of a kind" parts or parts in small quantities for their projects. To repair and maintenance people, too, this block's flexibility should prove excellent for replacement purposes, and a great time saver.

All parts necessary to assemble a wide assortment of terminal blocks, according to this bulletin, are provided in these kits. Kit No. 200 contains necessary molded sections, terminals and screw assemblies, and Kit No. 201 has a balanced supply of end brackets, partitions, threaded rods, screws, nuts and washers. Thus, with the correct ratio of these kits, all sizes of blocks may be built, meeting specific requirements easily and quickly. Complete instructions are included with each package. The blocks are recommended for installations where the temperature does not exceed 400 F.

150 HP Cyclotherm Steam Generator

We Harness the Cyclone's Force

The furnace tube of a Cyclotherm Steam Boiler in operation houses a cyclone of fire—safely and automatically controlled. By applying to combustion the same principle that gives a ruthless "twister" its destructive power, Cyclotherm engineers offer the world a new and better steam boiler, one that does more efficient work for you at less cost than you have ever known.

The patented Cyclotherm method consists of burning the atomized fuel in a rapidly revolving cyclonic flame completely in the first pass. This highly radiant cyclone of flame travels relatively slowly through the length of the furnace tube with the result that heat is radiated intensely and uniformly.

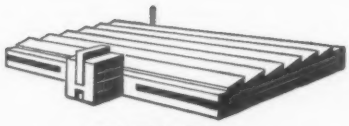
Cyclotherm units of 80 to 300 HP are equipped with an automatic modulating steam pressure control system which provides the proper quantitive fuel-air relationship for all firing rates with oil (or gas) and air pressure constant. Firing rates are modulated from 30% to 100% of rated capacity in response to steam demand. Units of 10 to 60 HP utilize the "on-and-off" method of operation which is immediately responsive to thermostat or pressure control and is more economical on small boilers. Both methods of firing are guaranteed 80% efficient.

Cyclotherm units are manufactured in sizes from 10 to 300 HP with operating pressures from 15 to 200 psi and a steam output of from 345 lbs. per hour from feed water at 212° F to 10,300 lbs. per hour. For greater steam requirements, a battery of Cyclotherms is recommended.

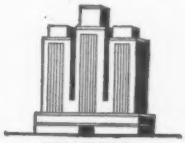
Prompt factory delivery assured.

For further information write for our specially prepared booklet 322-Z.

POWER



PROCESSING



HEATING

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, NEW YORK 4, N. Y.

New Products and Methods

Refer to 11-137

Pocket Electric Tester

A new handy pocket electric tester has been developed by the Star Fuse Co. marketed under the name of the SureTest Universal Tester.

The SureTest Universal Tester consists of an insulated sprocket around which is wound 6 ft of test wire. The test cord terminates at one end in a standard base plug, at the other end in two test prods. The test lamp is conveniently located in one of the test prods, and is protected by a filtered circuit to eliminate all false indications caused by adjacent live wires, inductance and body capacitance. A high resistance is enclosed in the other test prod to avoid accidental grounds.

The special filtered neon test circuit, by eliminating false glows gives the equivalent test results of a large carbon lamp.

A feature of this vest pocket tester lies in its design for continuity testing. Inserting the attached plug into a base receptacle enables the user to check continuity with the test prods. Bench testing of motor armatures, coils, flourescent lamp units, radios and other appliances is readily accomplished in this fashion. The continuity testing features are adaptable to the quick checking of electrical circuits in automobiles, and airplanes, and to the tracing of signal circuits such as in elevators.

Power circuits of from 110 to 600v are tested by inserting the rubber plug into the self-contained socket on the frame of this device. The test prods are then used in the conventional manner for location of blown fuses, or detection of "grounded" appliances.

An important electrical testing application from the standpoint of safety is the inspection of portable appliances for "grounds."

Refer to 11-138

COMBINATION BALANCING VALVE AND AIR VENT

Increased popularity of radiant heating for all types of buildings throughout the country has prompted Homestead Valve Manufacturing Co., Inc., to start production of a combination balancing valve and air vent for such installations.

Designed by D. H. Butler, Pittsburgh industrial consultant, and Homestead production engineers, the valve is called "Radiantrol." Its use is expected to reduce materially installation cost of radiant heating systems because additional piping, fittings and welding required for air vents are eliminated.

Basically, the purpose of balancing valves in radiant heating systems is to regulate water flow to individual coils in accordance with the comfort conditions required in the area serviced by those coils. One valve generally is used for each coil. Air vents are specified by most engineers to insure against air-lock even though radiant heating systems operate at relatively low temperatures.

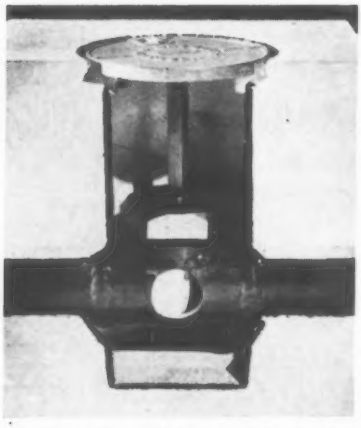


Fig. 1. Fiber shipping container becomes concrete pouring form which fits snugly over the pipe. Even after the concrete work has been completed the entire valve is accessible at all times

This new valve is somewhat similar to a butterfly type control valve. It can be used with pipe coils buried as deep as 8 in. below the concrete surface because the hollow brass control stem can be cut to appropriate size. The stem extends from the valve to a brass floor plate 3⅝ in. in diameter marked to indicate open or closed position. This traffic plate fits flush with the concrete floor and can be operated by foot. A slightly different model also is manufactured for hand operation. These are designed to be located in a valve pit or off the floor in a cupboard or similar location.

The valve disc is built into a wrought iron body, made of a short piece of pipe end-beveled to facilitate welding into a section of the heating coil. Since the most popular sizes of wrought iron pipe used for radiant heating systems are 1 in. and 1¼ in., according to records of thousands of installations, this company is manufacturing Radiantrol valves in the 1¼ in. size, which is adaptable to both 1 in. and 1¼ in. pipe. Additional sizes will be made later as the demand warrants.

Venting a radiant heating system with this valve is accomplished by removing the brass floor plate and hollow stem, and turning a small cap screw on top of the valve bonnet which is drilled to permit escape of air from the piping system.

The fiber container in which the valve is shipped is so designed that it may be used as a concrete pouring form. This eliminates the additional cost of concrete forms. Slots can be cut in the container to fit snugly over the pipe so that no concrete will flow around the valve itself. The entire valve is accessible at all times and can be easily dismantled and repaired even after the concrete work has been completed.

First use of the Radiantrol valve was in a radiant heating system recently installed at the Union National Bank of Pittsburgh, Pa. In this bank, wrought iron pipe coils were positioned on an old floor and a new floor was installed over them.

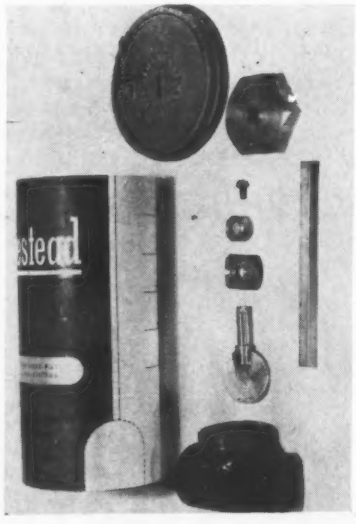
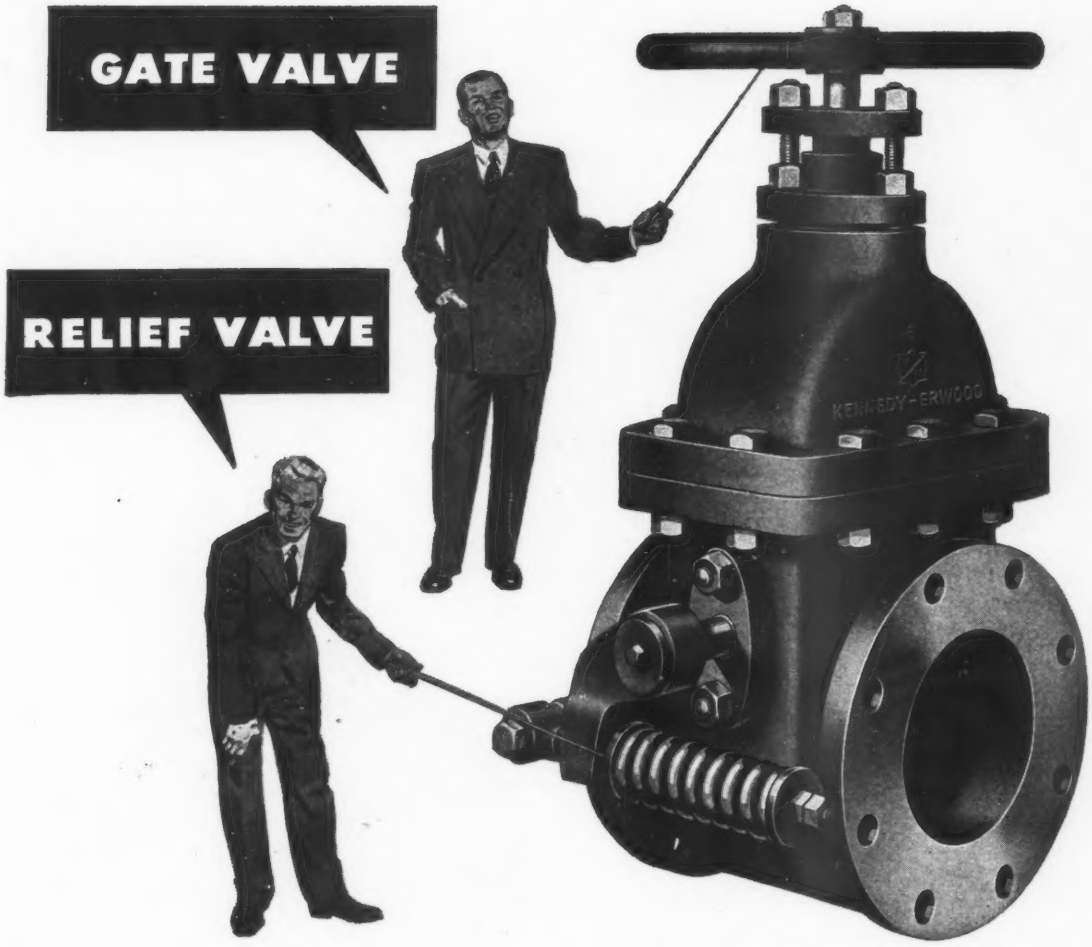


Fig. 2. This photograph shows simplicity of construction of the valve



Protects Low Pressure Equipment

TYPICAL APPLICATIONS OF THE KENNEDY-ERWOOD VALVE

- *Non-return valve on exhaust lines between steam turbines and condensers. Relief valve on low-pressure stages of turbine casings.*
- *Back-pressure or atmospheric-relief valve on turbines and condenser engines.*
- *Safety gate valve on low-pressure exhaust lines and headers.*

Here is a unique combination valve with important advantages not obtainable in any other design.

For normal operation, the Kennedy-Erwood Valve can be manually opened and closed, just like a standard gate valve. However, if the back pressure exceeds an amount that would be dangerous for the apparatus which the valve is to protect, the predetermined spring pressure permits the disc to open and relieve the pressure. Therefore, it also functions as an automatic relief valve.

Wherever low-pressure apparatus is to be protected from excessive pressure, the Kennedy-Erwood Valve is an essential insurance against the possibility of costly damage. It is widely used for this purpose by central power generating stations and manufacturing and process plants.

Write for complete information and prices on suitable sizes for your requirements.

THE KENNEDY VALVE MFG. CO., ELMIRA, N. Y.

Offices and Warehouses in Principal Cities

KENNEDY valves-pipe fittings-fire hydrants

SMALL TRAP

BIG *Performance*

Little? Sure. But what a giant's job they do!

That's how men judge Yarway Impulse Steam Traps.

Yarways are well suited for trap service throughout industry. The small size itself is an important feature. They are easy to install, fit in anywhere, require no special supports.

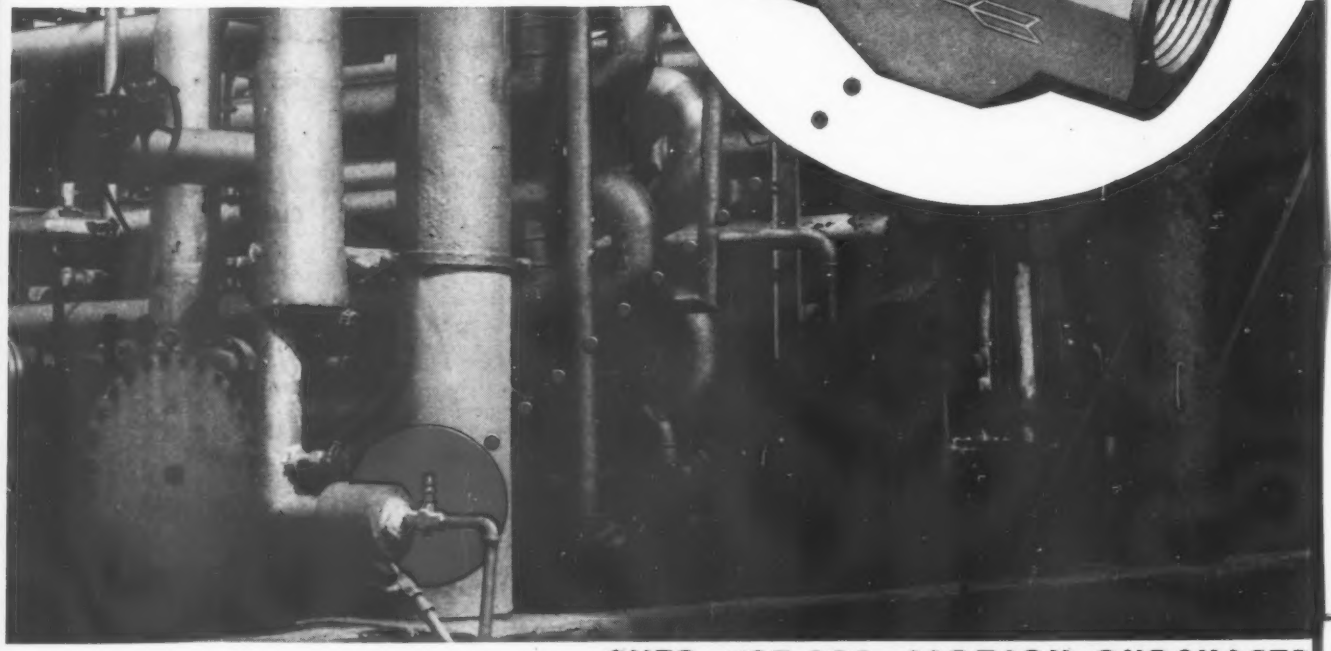
In service they *drink* condensate, discharging *continuously* on heavy loads, at short *intervals* on light loads—providing maximum heat in the shortest time, and keeping equipment at top efficiency.

Yarways are suitable for all pressures without change of valve or seat. Simplicity of construction (only one moving part) minimizes maintenance. Also, initial cost is low.

Try some Yarways today—standardize on them tomorrow. See your nearest Supply House or write for Yarway Bulletin T-1739.

YARNALL-WARING COMPANY

145 Mermaid Avenue, Philadelphia 18, Pa.



OVER 525,000 ALREADY PURCHASED

YARWAY IMPULSE STEAM TRAP

Plant Engineering

A new magazine with 50 years of experience

DESPITE WAR and destruction, shortages and high costs, American living standards are the envy of the world. These living standards were made, and, are maintained by, industrial ingenuity and mass production. Low cost, mass production in turn depends upon the effective use and application of power in its many forms. This is the lever by which man's productivity is increased, by which living is made easier and creature comforts provided.

During the past half century, the growth in generation and utilization of power in all forms has been amazing. For this 50 years, POWER PLANT ENGINEERING has been a part of this growth. Trends have been followed from day to day. Advances have been encouraged. New approaches have been pointed out. From simple steam engines and line shafts, highly complex organizations for power supply, distribution and application have developed.

This growing complexity has encouraged a definite separation of the power field into two major functions. The first function is accomplished by those engineers responsible for the generation of power, in some form for industrial or service establishments, institutions and utilities. Essentially this covers the operation of an industrial establishment manufacturing some form of power for sale, either to the public in the case of a utility power plant, or, to a member of the family in the case of a industial power plant.

The second function is accomplished by those engineers responsible for the application and maintenance of those and related services throughout the balance of the establishment.

This trend or split in function became pronounced after the first world war. In the ensuing years various expediencies were adopted but adequate changes were delayed by the war with its resultant manpower and paper shortage. Now the functional separation has fully crystallized, paper and mechanical facilities are available and the change has been made.

What Plant Engineering Will Cover

A new magazine, PLANT ENGINEERING, has been started. This magazine will deal with power application, utilization and maintenance as one phase of plant engineering, which in its broad aspect covers the complete service function necessary to support the principal output of the plant whether the output be automobiles, paper service or scholars. This service function will be construed to cover the engineering, layout and construction of the facilities for carrying on operations an dcaring for personnel, installation of equipment, distribution and application of electricity, steam, gas, air, water, sewer and hydraulic lines, as well as maintenance of all physical structures, equipment and services.

In other words PLANT ENGINEERING will be developed to the needs and interests of those men who are responsible for the general operation and maintenance of the entire plant. While plant engineer is perhaps the most commonly used term, industrial organization is so diverse that the function in a given plant may be performed wholly or in part by the chief engineer, works engineer, maintenance engineer, manager, superintendent or a score of other titles.

PLANT ENGINEERING will be a practical magazine in that it will be edited to help the plant engineer with his everyday problems. The articles will be understandable and aimed at helping the engineer do his job better. Engineering, planning, cost and training requisites will not be allowed to overshadow the needs of practical maintenance men such as electricians, pipe fitters, millwrights, painters and carpenters.

PLANT ENGINEERING, however, will not concern itself with production. It will, however, concern itself with the power supply to such equipment. It is the Plant Engineer's function to see that the wiring is adequate and the regulation of the power supply such that it can withstand the loads. Similarly, PLANT ENGINEERING will concern itself with such matters as steam distribution throughout the plant, with plumbing, heating, and drinking water systems.

It will carry articles dealing with illumination, with the protection of surfaces of machines and buildings, with repair methods, problems in rigging, scaffolding and all general maintenance of buildings and grounds. There will be articles on process safety, including corrosion control and fire protection. Materials handling comes within the province of the plant engineer and so there will be articles on conveying systems and application of all kinds of trucks for the handling of manufacturer goods.

Many Regular Features

Mechanical transmission will be an important feature of the new magazine and all aspects of modern mechanical transmission will be covered. Another important aspect of general plant operation is instrumentation and measurement. Considerable attention will be given this subject, involving everything from the use of electric strain gages to determine floor loading to the detection of toxic gases and control of radio interference from inductive equipment. All phases of intra-plant communication will be treated and there will be considerable elementary electronic material.

An important part of the new magazine will be a large New Equipment and Methods section, carrying brief announcements and description of new commercial products. There will be a very complete Catalog section, listing new catalogs and manufacturer's literature. A vigorous "Maintenance Hints" section will be of particular value to the plant electrician, the millwrights, steamfitters and other mechanics. There will be a useful and interesting Question and Answer section where readers will be given the opportunity of presenting their problems and at the same time helping others to solve theirs.

To conserve the time of the busy engineer exposed to all sorts of literature, PLANT ENGINEERING will carry, as a regular department, a Digest section or short abstracts of important articles in other publications, both domestic and foreign. Important articles in manufacturers house organs will also be included in this section. And last, but not least, there will be a good Plant Engineer's Library section, containing announcements, brief descriptions and reviews of new books.

In short, PLANT ENGINEERING will be a useful magazine, one that the plant engineer and all of his subordinates will find of increasing value as the years roll on.

General Classification of Subject Matter to be covered by Plant Engineering

1. Distribution and application of electricity, steam, water, compressed air, and other liquids and gasses.
2. Mechanical power transmission, belts, pulleys, chain drives, speed changes and bearings.
3. Illumination, natural and artificial.
4. Air conditioning, heating, cooling, ventilation, dust and fume control.
5. Refrigeration for space cooling and process.
6. Sanitation and personnel services including wash and locker rooms, toilets, parking and guard systems and vermin control.
7. Materials handling.
8. General building and grounds maintenance.
9. Installation of equipment.
10. Safety, fire, machine, process and personnel.
11. Communication, alarm and public address systems.
12. Construction and repair of structures and equipment.
13. Lubrication, lubricants and industrial fuels.
14. Instruments, measurements and control.
15. Planning, organization, cost and inventory controls, training and educational techniques.
16. Plant design, building layout, piping and electrical distribution.

We Advance Through Research but MAINTENANCE Keeps Us Going

We can conceive of an idea for a new machine, lay it out on paper, see that it is built to dimensions in the shop, sell it, and make sure that it is properly installed, but unless provision is made for the correct maintenance of the machine we have wasted a lot of effort

By H. R. MEYER ***Manager, Maintenance Sales, Westinghouse Electric Corporation***

MOST OF US WILL agree that war is the most destructive element in our world economy, the effects of which we never fully overcome. To these effects the average citizen is never entirely aware so long as natural resources continue in apparent abundance. It is only when one by one, those resources start to dwindle that the man in the street is made to realize, through shortages and higher prices, that wars use up materials and manpower that can never be replaced. However, there is another and happier side of this picture that is at the same time a rather sad commentary on the initiative of even our progressive country. Due to the need for vast amounts of materials of all kinds in the shortest possible time, a state of war makes essential the speeding up of our thinking processes, as well as mechanical operations.

With the demand for greater quantities of the weapons of war already developed there comes a need for machines of construction as well as destruction. Ideas which over the years have been only partly formulated are taken out of their pigeonholes and developed into usable form. Again, as in the case of Nuclear reaction research work, which had been moving along in the even tenure of its way, it suddenly gets the green light and all the necessary money to result, finally, in the greatest discovery of all times—the release of great quantities of energy from relatively small amounts of matter.

What is true in the way of new machines is also true of that most important of all of our economic functions which we call "maintenance." For years most of us have agreed, when the question was considered at all, that everything that moves will wear. Unfortunately, however, few of us did much with that knowledge. It is true that maintenance of a kind was provided for all operations but many of the programs well started were not fully carried out. The results were, of course, obvious in too much down time and excessive repair bills.

It is my observation that World War II did more to advance the art of maintenance than any other event in the history of our country. Here again, however, we see the result of a need rather than an instinctive urge to improve a situation that has existed for years.

Shortly before our entrance into the recent conflict, the Westinghouse Co., as part of its countrywide maintenance educational program, promulgated the idea of Preventive Maintenance. The main concept of such a program is to so set up the system of maintenance for a given manufacturing operation that much of the larger repair work would be eliminated. Basically, it substitutes a schedule of periodic inspections that will catch future troubles in the incipient stages for excessive and costly repair work.

Before going into the question of, what's new for maintenance, I would like to emphasize at this point the importance of a fundamental inspection schedule. Preventive Maintenance immediately implies a necessity for something over and beyond the general concept of normal maintenance operations. In too many cases the care and upkeep of facilities and machines is considered in terms of repair rather than the prevention of these repairs. If we are to cut down the cost of maintenance; and, at the same time, prolong the life of our equipment, we must start now to do those things which will help to bring this about.

Of all the things required of a maintenance organization the proper scheduling of inspection is the most important. Many apparatus failures can be prevented if the defects or

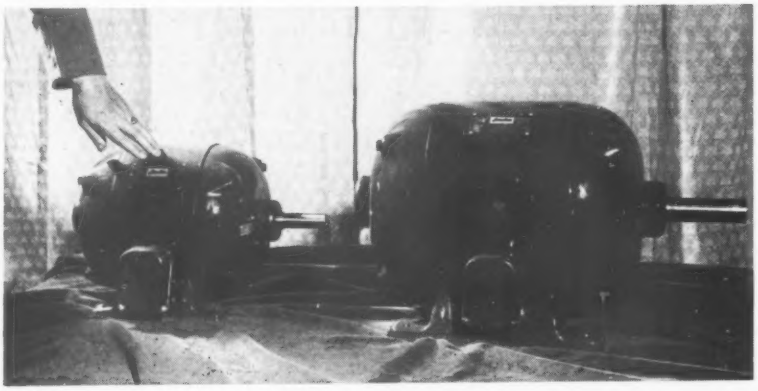


Fig. 1. Totally enclosed 5 hp Silicone insulated motor compared with a 5 hp motor with Class A insulation

faulty operation are checked in the incipient stages. Frozen bearings are, as a rule, the result of improper lubrication and this, in turn, is brought about by lack of knowledge and attention. Burned out armatures and stators are, in all cases, caused by heat.

Analysis of many troubles indicates that, initially, the trouble started from malfunction of just a small detail. A complete sub-station was wrecked through overspeeding of a machine but the overspeeding was caused by the breaking of a small fiber washer on a rheostat. Many motors when applied have sufficient capacity. However, conditions change and unless checks are made periodically, a motor may burn out without notice and shut down an important operation.

Very few operators today have any idea of what it costs to maintain a given piece of equipment over a period of years. Numerous attempts have been made to set a figure of cost for a given line of motors, but there are few, if any, figures available. We believe that included in a good maintenance schedule there should be a record of each important piece of apparatus which will show at least the cost of repairs and the renewal parts used. There is, of course, in addition to that cost, a part of the overall maintenance function.

In too many cases this detail work seems unnecessary and expensive. As a matter of fact, the money is now being spent in the high rate of repair work. The cost of maintaining any piece of apparatus assumes considerable importance when it becomes necessary to buy replacements for, or additions to existing plant. If the maintenance cost of a particular machine appears to be high, an investigation is indicated. Certain operating conditions involve high maintenance costs. There are many others, however, where the application may be wrong or misalignment is causing the trouble.

One more thought before I leave this subject and to bring out more clearly the advantages of proper scheduling of inspections. In addition to the necessary budgets for the run of mine maintenance work it is essential that we provide for those jobs that occur infrequently, such as the cleaning and overhaul of large machines which run two and three shifts. The time when these machines will be available for inspection is limited, and since they run for relatively long periods, budgeting for the expense should be set up on an accrual basis. This will tend to even out maintenance expense over the years and the money, if properly protected, will be available when needed.

One of the greatest exponents of good maintenance W. A. Perry of the Inland Steel Co., East Chicago, Indiana—in a paper presented before the Pittsburgh District Section Association of Iron and Steel Engineers, in 1940, stated very emphatically that the savings are not only very real but really worthwhile the effort involved. As complete cost records on maintenance have been kept over a period of years by this company, direct comparisons are easily made. While no actual cost figures are given, he did show that after a system of Preventive Maintenance had been in operation for a few years labor costs were cut 69 per cent; labor hours 72 per cent, and material costs 52 per cent.

While these savings are little short of miraculous, and directly effect the final cost of the product, there was a further saving which is of great importance to those operations where continuous performance is essential. Delays, due to failures of machines, were cut by 63 per cent. To anyone charged with the responsibility of keeping production at a high rate this item is a most important element and the goal of all maintenance programs.

For too many years the cost of maintenance has not received the attention due it as a factor in the cost of the product being manufactured. This, in my opinion at least, is brought about by lack of appreciation of the part that this item plays in our complete economy. A little explanation of some of the maintenance costs in these United States will, I believe, increase the respect that is due this operation.

There is no better example of the effect of maintenance on the cost of operation than that found on our

Biographical Sketch of H. R. Meyer with Westinghouse

1. **Entered Westinghouse as graduate student 7-7-1913.**
2. **Six months shop and classroom work.**
3. **Hard times aknockin' at the door and not a motor on the test floor, so started in with Control Engineering making diagrams.**
4. **In March, 1914, was put in Railway Engineering on control design.**
5. **Strange as it may seem, by October, 1915, I had become an expert and was sent to Canada to install automatic high voltage d-c equipment on the cars of the Lake Erie & Northern Railway, at $65.00 a month. (There was nobody else to send.)**
6. **Returned January 1 as Manager of High Voltage d-c Control Section. (F. G. Hickling, former manager, went to Pittsburgh Office as Transportation Manager.)**
7. **In 1920, Railway Engineering was split up and I became Manager of Light Traction Application under Mr. F. E. Wynne. Laid out and installed first trolley coach equipment on Packard truck in Detroit.**
8. **In 1922, went to Development & Supply Sales as Assistant to Mr. J. L. Crouse.**
9. **In 1926, I was a Specialist on trolley coach equipment under Mr. A. J. Manson, Manager of Transportation Sales.**
10. **In 1928, Manager of Transportation Renewal Part Sales.**
11. **In 1940, Acting Manager of Maintenance Sales Department to set up country-wide maintenance program.**
12. **In 1941, Manager of Maintenance Sales.**

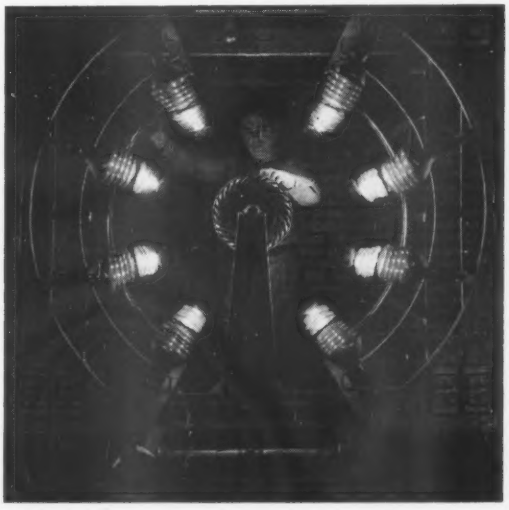


Fig. 2. Armature baking with infra red lamps reduces baking time as much as 70 per cent

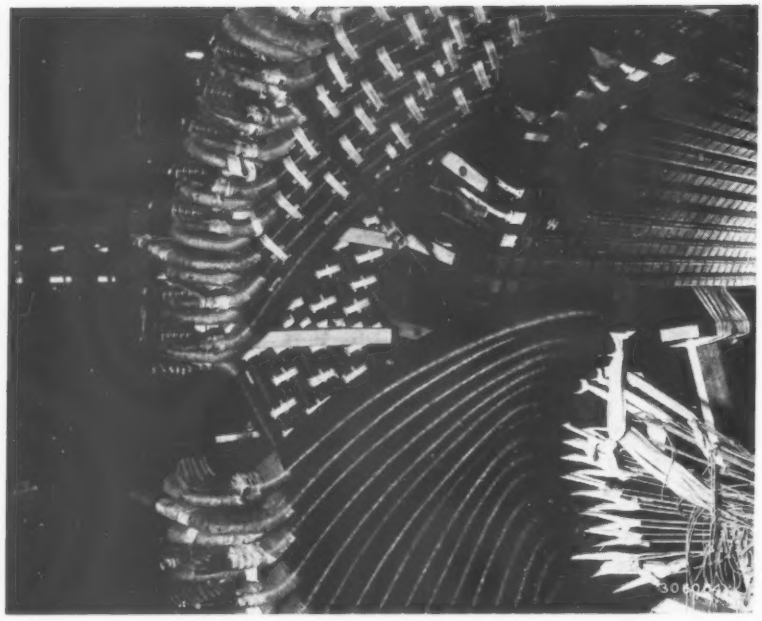


Fig. 3. Application of glass insulation to rotating machines

Class I railroads. Back in the year 1936 they spent a total of $1,237,809,752 for the upkeep of ways, structures and rolling stock. For the year 1945 this same operation cost them $3,561,400,000, which represented about 40 per cent of their total revenues. In 1946, this maintenance cost, while lower, still represented 34 per cent of total revenue. That year's bill was $2,619,200,000. When you have a business that requires between 30 and 40 per cent of your total income for maintenance of the tools of production, you are always conscious of the fact that this item is really important.

Of course, to make a point, I have picked an industry where maintenance is on the high side. However, while maintenance in other industries is not so obvious, it is nevertheless an important item. It is important for two reasons: first, the effect of its cost on the price of the finished product; and second, the effect on the quality of that product. In the steel industry a good average figure for maintenance is around 7½ per cent of sales. This is for those mills that operate their own blast furnaces. For mills that do not have blast furnaces the bill is about 5 per cent.

Getting down to the general run of manufacturing we find that maintenance drops off to 2 to 4 per cent of total sales. Here again, however, we must not underestimate the importance of the operation. Although maintenance represents a relatively small percentage of total cost and sales, its lack can have disastrous effect on the quality of the produce being produced. In mass production all parts must be interchangeable, and where close tolerances are involved, all machines must be kept in top notch condition. This can only be done by a closely controlled schedule of inspections, lubrication and regular periods of overhaul.

What Is Maintenance

We now come to that important question—What is maintenance and what constitutes its essential elements? While it might be defined in a number of ways, I like this one—"Maintenance is that operation which, through periodic inspection, repair and replacement of parts, assures maximum life and production capacity."

In maintenance work, as it should be carried on today, there are, among many details, two main functions that are essential if the best possible job is to be done. First, is that item of prime importance — a complete maintenance program by the operator of the equipment; and second, the part that the manufacturer plays. It is with this latter phase that I am dealing for the moment.

With the highly competitive market that exists on most fabricated items, particularly those in the electrical field, it is obvious that constant research work must be carried on. That such research will not only continue but must be intensified, is indicated by the speed at which we are now using up our natural resources. We must start soon to consider the more efficient use of materials or on some elements we may find ourselves in the same position of many smaller nations who are continually fighting for a place in the sun and a higher standard of living. Anyone who is skeptical about the fact that we are fast using up the resources that helped to make this country great can get a rude shock by taking a trip to the town of Hibbing, Minnesota, about eighty miles north of Duluth. Just a glimpse at that big hole in the ground, with an eye cocked towards those workers who are scraping up with hoes the loose iron ore, should remove any remaining doubt.

Of course, there is still a lot of iron ore in his country but to get it into usable form will not be so easy, or as cheap as shoveling up loose material which runs between 50 and 60 per cent iron. Right now a very serious development program is being carried on by the larger mining companies to find ways and means of extracting the iron from more or less solid rock. What is true of iron is not so true of some of our other metals. Many estimates have been made of the known quantities of those materials still available and they don't look so good if we are to continue at the present rate of production.

While war is a great waster of natural resources, it also starts the creative juices working to the end that man may always have a substitute for the things that are going, or gone. A shining example of this is glass insulation and the part that it has played in our production operations during the past nine years. While this item was not a War Baby, it is playing a great part in this after-war conservation period. With the difficulty encountered in obtaining that other important Class B item—Asbestos—during the war glass insulation really came into its own.

As an example of the growth of the use of this material, our company, in the year 1938, purchased for coil insulation $38,000 worth of glass tapes, yarns and cloth. Just five years later, in 1943, our electrical machines were insulated with this material in the amount of $960,000, and since that time it has run as high as $1,500,000 per year.

Glass Insulation

Glass as an insulating medium has been with us long enough for most of the kinks to be ironed out and to provide us with data as to what we can expect. In the war effort its use permitted the production of motors for special purposes that could not otherwise have been made. It is the higher operating temperatures made possible with glass that are going to be of great aid in conserving materials in this post-war period. Before the war, the average temperature rise for general purpose industrial motors was only 26 C. Just imagine the possibilities in that field with glass permitting a temperature rise of more than 75 C with organic varnishes, and about double that figure with Silicones.

Steel mill, electric railway and the mining locomotive fields have already taken advantage of the higher permissible temperatures in rewinding motors that were overloaded. On the other hand, glass insulation makes possible the design of smaller motors for the same horsepower, which is an end we must achieve if we are to make a start on that conservation program so necessary for the immediate future. We have reached a point, today, where glass insulation has come of age and is now accepted as not only a standard, but also a very vital addition to the family.

Although glass insulation, as such, is now an accepted fact, we have not been able to take full advantage of all of its characteristics. Glass insulation without a varnish treatment has very little dielectric strength. For many years the only varnishes available for the treatment of cotton, asbestos, glass, and other materials, had a relatively low maximum heat limit. As the melting point of glass in fiber form is around 500 C it is obvious that the field was wide-open for a new varnish. Again, the resourcefulness of the engineers came to the rescue. Out of the crust of the earth they developed a relatively high temperature varnish known as Silicone.

Fig. 4. Open ore pit at Hibbing, Minnesota

Silicones

The history and development of this new impregnant is a complete story in itself, but for our purpose here it will be sufficient just to hit the high-spots. Although the basic formulae for Silicones are not new, it was not until the past few years that a serious attempt was made to develop it into practical materials. The first commercial Silicone varnish was brought out by the Dow Corning Corp. of Midland, Michigan, under the trade name of D. C. 993. In treating insulating materials with this varnish a baking temperature of 250 C was required. The finished product with glass as the basic material, is capable of withstanding temperatures up to that point and beyond.

Those of you who have had experience with the dipping and baking of armatures realize that very few shops are equipped with baking ovens that have a temperature range wide enough to handle this new varnish. A few high temperature ovens have been installed but lack of a sufficient quantity tended to hold back on the use of this new material. Realizing that a varnish with lower baking temperature but with similar final characteristics was required, the Dow Corning chemists came up with a new Silicone known as D. C. 996. This varnish has a baking temperature of only 150 C, which is well within the limits of the average oven.

With the glass insulation base and a Silicone varnish impregnation we now have an insulating medium that will permit the design of electrical machines with lower power-weight ratio. This, of course, helps pave the way for that conservation of our natural resources which is essential if we are to continue as the leading nation of the world.

Several thousand motors that were operating under severe overload conditions, or under high ambient temperatures, have already been rewound with coils completely insulated with Silicone treated glass. Recently, Westinghouse designed for the machine tool industry, a five horsepower, totally enclosed motor with Silicone insulation on a five horsepower open frame. A mill motor using this insulation has also been made available.

To give a rather comprehensive idea of what can be done with this versatile material we rewound a 2500 hp motor with Silicone insulation to deliver 4200 hp. Through an oversight in testing it ran for several hours at 6300 hp without any apparent detrimental results. It is just a question of how hot a motor or generator can run under the conditions in which it is used. Obviously, there are applications where a hot motor is not desirable. At the same time there are many operations where a hot motor will do no harm.

To the maintenance man who understands the conditions under which his equipment operates there will arise the question of bearing lubrication with this increased heat. This problem has been taken care of to a great extent with a series of Silicone greases and oils. Some of these have been used with considerable success. One important factor which should be kept in mind when considering the use of Silicone insulation is that of the ultimate continuous temperature. There will be many applications where its use is warranted but the temperature will be only slightly above that which is now safe for what we have considered Class B insulation. In these cases the lubrication problem will not be so important.

Increasing temperatures beyond the present limits effects no other parts of an a-c motor than, possibly, the bearings. It is for this reason that most of the applications of this new insulating treatment have been made on this class of motors. Much experimental and development work has been done on d-c motors, especially since the advent of Silicone varnish D. C. 996 (150 C). However, with this class of motor other parts besides the windings and bearings must be considered.

Editor's Note: This is the first of two articles on this subject by Mr. Meyer. The second, dealing with a number of specific maintenance methods will appear in the next issue.

SALES OF NATURAL gas by utility companies in the United States for the year ended July, 1946, amounted to 22.4 billion therms, a decline of 1.9 per cent from the year previous. Manufactured gas sales were 2.05 billion therms and mixed gas sales about 1.2 billion therms. A therm is a unit of measurements equivalent to approximately 190 cubic feet of manufactured gas, 120 cubic feet of mixed gas, and 95 cubic feet of natural gas.

How to Evaluate Centrifugal Refrigerating Machines

By CLARK T. SHIELDS
Assistant Product Manager, Heavy Machinery, Carrier Corp.

Plant engineer wants simple, compact units, to give long, continuous trouble-free operation . . . One of important factors in getting this is construction of unit for serviceability . . . How heat exchangers can be built for convenience in maintenance . . . Construction of bearing chambers for good maintenance . . . Manifolding of external connections . . . Eliminating external moving parts . . . Use of proper materials . . . Design for possible changes in operating conditions . . . Shaft seal important

HOW DOES a plant engineer evaluate competitive bids on equipment and make his recommendation to management?

Actually, there are many ways in which an operating staff might evaluate a machine. Fundamentally their requirements are a unit that is simple to operate, compact and trouble-free; one that will give long years of uninterrupted service. They also want a unit backed by an organization, which, if trouble does occur, can and will supply competent and well trained service and installation engineers, to help remedy their trouble.

All too often the refrigeration plant is bought on first cost. This may or may not be a good buy. One of the angles that should be investigated when evaluating the purchase of a new refrigeration plant is service. Any unit of mechanical equipment requires a certain amount of maintenance and inspection to keep it free of major troubles. As a result of years of operation, most centrifugal refrigerating units now incorporate features designed to make this problem a simple one.

Heat Exchanger Maintenance

Any heat exchanger requires annual inspection of the water side, at least. There is just no getting around that fact. Realizing the operating engineer's problems with respect to cleaning and maintenance of the heat exchangers, designers have worked out coolers and condensers provided with water boxes and cover plates. The line connections are located in the water box. The tube bundle is completely exposed when the cover plate is removed. There is no need to break into the water or brine lines. Figure 1 shows a completely assembled centrifugal refrigeration unit, and a little study will indicate how convenient it is to inspect the tube bundle after the covers have been removed.

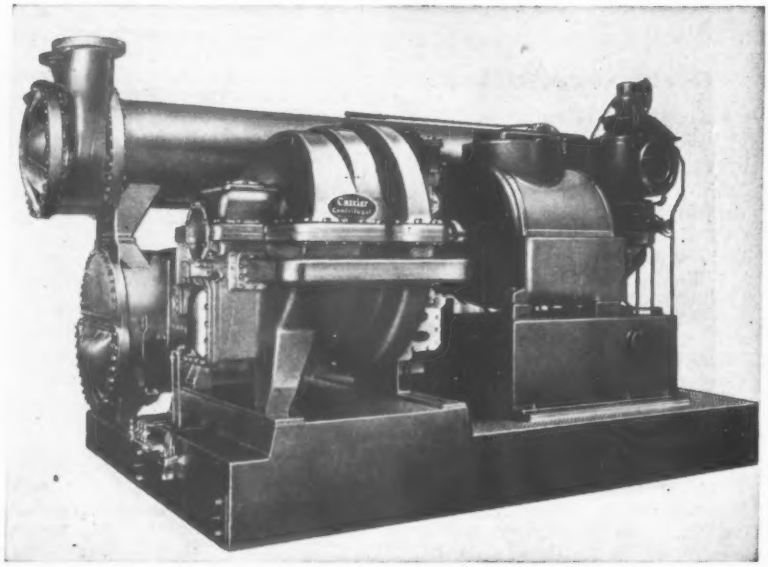


Fig. 1. Centrifugal refrigeration compressor driven by condensing steam turbine, showing design for good serviceability

Accessibility of Bearings

The compressor should have inspection cover plates on both the seal end and suction end bearing chambers, as shown in Fig. 3. These covers make it possible to open the chambers and remove the main journal bearings, without disturbing any other portion of the machine. When inspection is as simple as this, the inspection is more likely to be made. When the inspection cover is removed, the bearing cap is exposed and, by the simple means of removing two cap screws, the complete upper half of the bearing is removable, as in Fig. 2.

The bearing cap comes off, the upper shaft bearing liner retainer is removed, and the upper bearing liner can be lifted off and inspected. Then, by slightly lifting the compressor shaft, the lower half of the bearing may be removed with a simple, easy twist. Complete inspection and replacement of the main journal bearing liners has been accomplished in as short a period as three hours.

The bearings mentioned above are made of a bronze liner with a babbitt face. These are Federal Mogul bearings. They are precision bored, and do not require any scraping or fitting at assembly; but need merely be inserted into the shaft bearing liner retainer. The lubricating oil is furnished by a gear pump driven from the compressor shaft. Oil is supplied under pressure to all points requiring lubrication.

With the suction end inspection covers removed, the compressor thrust bearing may also be inspected.

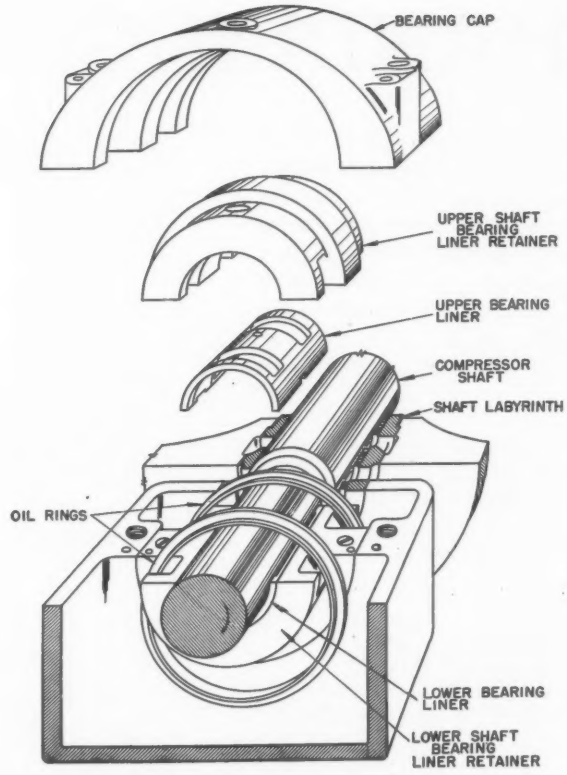


Fig. 2. Main bearing assembly on a centrifugal refrigeration compressor

External Moving Parts

Another point that is definitely worth the operating engineer's consideration is the absence of external and auxiliary moving parts. The centrifugal refrigerating unit has a minimum of these external connections. The only ones that are really of any consequence are the oil cooling water lines. There are three supply lines,—one line supplying water to the compressor oil cooler, one line supplying water to the gear oil cooler (on a motor-driven unit), or the turbine oil cooler (on a turbine-driven job), and the third line supplying cooling water to seal jacket housing.

All other oil piping and equalizing connections between the two ends of the compressor can be enclosed within the shell or housed in a manifold which runs from the suction to the discharge end. This assures a minimum of external connections, which must be maintained in a vacuum-tight condition so as to prevent refrigerant loss or air leakage into the machine.

The only external part which has any moving parts in it is the purge recovery unit. This unit has a small reciprocating compressor. The purge may either be a remotely-mounted unit, or it can be mounted on brackets on the condenser shell. The main refrigeration unit should be designed so that its operation is not dependent upon the operation of the purge. The purge, of course, should be kept in good running condition. It has the definite duty of removing any non-condensables which might leak into the main unit. The purge is entirely enclosed within its own casing, and the only connections are the suction and return refrigerant lines.

Materials and Design Details

The cooler and condenser water boxes and covers should be of cast iron if the operating pressures permit. The reason for this is that cast iron has much better corrosion resisting properties than welded steel.

Cooler and condenser tubes must be easily replaceable. Even in the best regulated plants, accidents happen. Also, operating conditions may change, particularly in industrial plants, and may require a different type of tube material. If the tubes can be replaced on the job, this presents no major problem.

Tubes and tube sheets must be of similar material to prevent any electrolytic action.

The most satisfactory tube-to-tube-sheet joint is the rolled joint. This has been learned from past experience with steam boilers, marine condensers and other heat exchangers.

The condenser tube bundle should be protected from direct impingment of compressor discharge gas. High velocity gas can cut through a non-ferrous tube in time.

The cooler should be built so that the inside can be inspected without dismantling the machine or cutting the cooler shell. This may not be required often, but when it is needed, it is worth a lot of money.

The compressor should have a completely self-contained automatic oiling system, with a minimum of external lines and connections.

The compressor shaft seal should be of all metal construction. It should be so constructed so that there is no wearing or rubbing surfaces during operation. It should be completely automatic in its operation. The shaft seal should be investigated thoroughly because it is one of the most important parts of the compressor. If it does not work perfectly, the refrigerant loss can amount to hundreds of dollars a year.

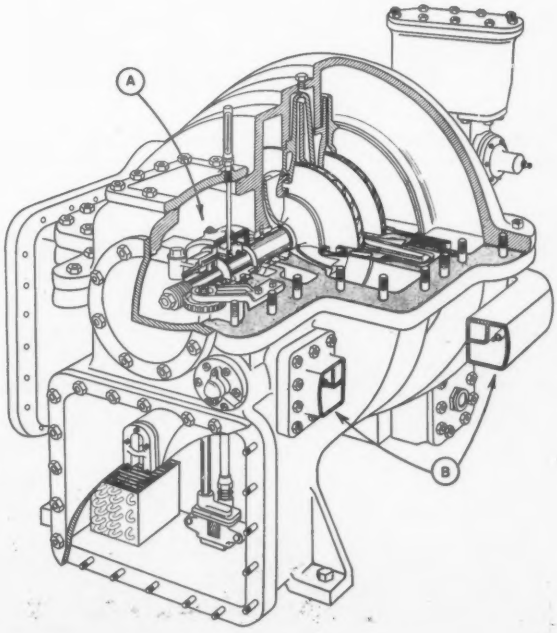


Fig. 3. Cut-away view of centrifugal compressor showing — A, how suction end bearing is exposed when cover plates are removed and, B — how oil lines and equalizing connections are combined in manifold

MATERIALS HANDLING

Installations of several types of materials handling systems used in industrial establishments . . . In foundries both overhead trolleys and track conveyors help to systematize and speed up the process Tube mills use chain conveyors as cooling racks . . . Milk products are conveyed mechanically while in process . . . Motor manufacture is a natural for mechanical conveyor application . . . Overhead trolleys have specific duties in food industries . . . Belt conveyors are well adapted for short hauls and elevating bulk materials . . . Food canning industries make extensive use of chain conveyors

Above: The conveying system in this modern foundry is arranged to receive the molds on trays, carry them through the molding line where pouring is done, then out in the yard where the castings cool and back into the building

Left: The trays on which the cooled castings are conveyed are automatically tipped so as to deposit the castings onto a rocking platform where molding sand is removed and reclaimed

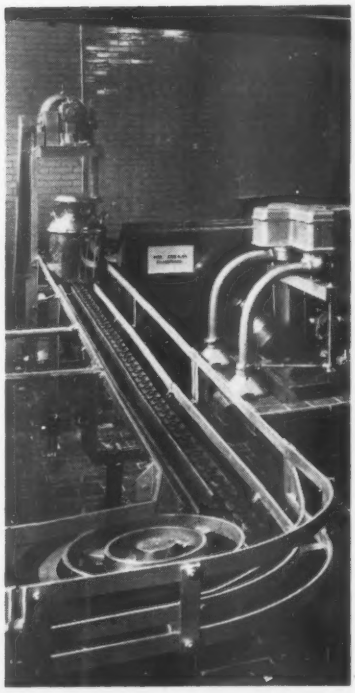
(Photos courtesy Fairbanks Morse & Co.)

Below: This Link-Belt 42 in. wide No-Leak steel apron conveyor in mechanized malleable foundry is used for chipping, inspecting and sorting of castings into tote boxes for transfer to nearby annealing department. It is fed at 90 deg (see background of picture) from a similar conveyor on which the castings are cooled and sprued

(Photo courtesy Link-Belt Co.)

Left: Take-up end of Link-Belt continuous mold-conveyor, in mechanized gray iron foundry, looking toward two shake out stations on far side of conveyor and toward sand Rivivifier (top, center). Note the automatic dumping cam arrangement at second shakeout. Observe also how the conveyor descends from shakeout level to the proper working level along the line of 14 moulding stations at right

(Photo courtesy Link-Belt Co.)



Above: The swivel conveyor has found a prominent place in the milk processing industry for transferring cans or boxes of bottle milk or cream from one section of the plant to another

Above: On these cooling racks tubes are conveyed along to storage at a very slow rate of speed and are cooled on the way. This is at the end of a long chain driven live roll conveyor

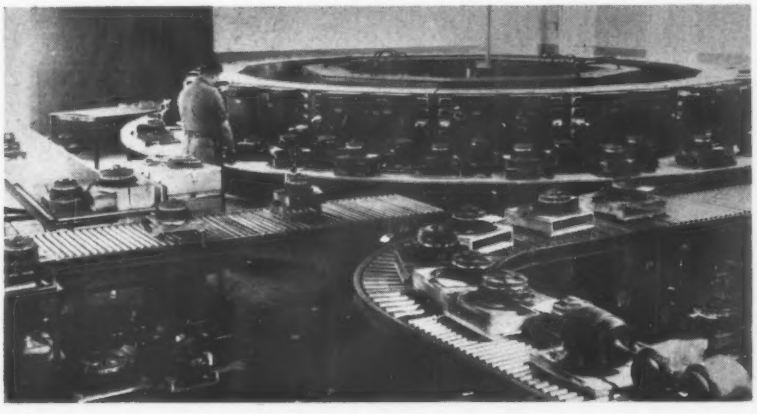
(Photo courtesy Chain Belt Co.)

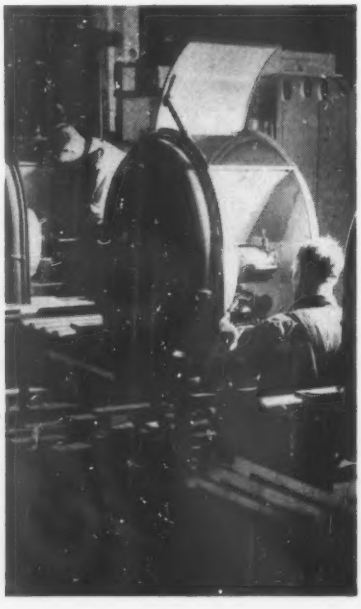
Below: This factory view shows how roller conveyors are used in the final assembly work on domestic stokers. Each section of the conveyor permits the workmen to walk completely around the stoker as conveniently as if it were on a bench yet the unit can be pushed forward from one station to the next without great manual effort

(Photo courtesy Fairbanks Morse & Co.)

Below: Roller conveyors find adaptation in factories where the progress of the products is intermittent and parts may be pushed along by hand aided in some cases by gravity due to the incline of the conveyor. This picture is the end of an assembly line where the motors are tested on a circular heat run table. Here the coils undergo an hour-long test at high temperature

(Photo courtesy Fairbanks Morse & Co.)





Above: Photographed at an eastern plant in the business of supplying raw eggs (yolks, whites or whole egg) to local bakeries, this picture shows drive corner of Link-Belt overhead trolley conveyor handling removable metal baskets into which girls place the candled eggs for transfer to another room where the girls break them into suitable receptacles

(Photo courtesy Link-Belt Co.)

Above: In the manufacture of small motors the roller conveyor system permits a stream of parts to flow to and from workmen as they perform this work. At this station a slotter cuts keyways

(Photo courtesy Westinghouse Electric Corp.)

Below, left: Overhead conveying systems are best suited to some factory operations. Shown here is one of many assembly lines used in the manufacture of motors at the Beloit Works of Fairbanks Morse & Co. The operation here consists of inserting, connecting, taping and testing stator windings. The stator frame hangs in a leather belt and is free to be rotated since it is supported by a pulley attached to the overhead trolley conveyor. The entire unit moves along slowly as the various operations are completed. Below, right: The assembly line conveyor has been developed to carry parts or whole units of machinery past workmen at a speed sufficiently slow to permit the desired operations to be performed. This picture shows the end of the assembling line where the electric motors are put together at the Beloit Works of the Fairbanks Morse & Co. At this station the motors are actually running while final inspection is carried on

(Photo courtesy Fairbanks Morse & Co.)

This is a new type asparagus washing and cutting unit which has incorporated in its construction cadmium plated detachable chain conveyor and spray nozzles. *(Photo courtesy Chain Belt Co.)*

Above: This picture is a close-up of a conveyor showing the full cans of tuna being conveyed. This whole tuna canning line is based on a capacity of 60 tons or 150,000 cans per day *(Photo courtesy Chain Belt Co.)*

Left: This new "merry-go-round" production line is speeding camera output at Eastman Kodak Co. The new conveyor system transports camera parts to the operators, then moves the assembled cameras on to packers and inspectors. Parts are in trays suspended from overhead track that goes 25 ft a minute. Operators remove trays as needed, put them back into the conveyor tray when camera assembly operation is done *(Photo courtesy Eastman Kodak Co.)*

Left: Handling of bulk materially is done rapidly with belt conveying systems which permit an endless variety of arrangements. This picture shows the conveying system of one of the largest sand and gravel plants in the West which utilizes six conveyor belts of different sizes. It is designed to handle 1000 tons of pit-run material an hour. Enroute from the pit to the stock pile and waste fines pile, the material is screened and crushed several times to obtain the desired finished product *(Photo courtesy B. F. Goodrich Co.)*

MODERN WASHROOMS . . . Maximum Service with Minimum Maintenance

Cleanliness and ease of maintenance key factors in choice of fixtures for industrial plants . . . Wall hanging of fixtures best because of ease in cleaning floor beneath them . . . Buy good seats; disinfectant and soaps can be used without harm to finish . . . Advantages of vitreous china urinals . . . Newest fixtures and fittings designed to play important part in morale and economy of plant operation . . . Types of drinking fountains and advantages of strategic locations throughout plant described

By GORDON McCARTY, *Plumbing and Heating Industries Bureau*

THERE has been a steady improvement in the sanitary facilities in industrial plants in recent years. Obsolete latrine-type closets have been replaced with modern sanitary closets; up-to-date washing facilities have been installed; angle stream drinking fountains have replaced the hazardous common drinking cup; and shower baths have been installed in many factories.

Management has discovered that good washroom facilities more than pay for the original cost of installation by better production on the part of the employees and lower cost maintenance.

Wall Hung Fixtures Preferable

In a modern washroom all fixtures and partitions should be wall hung. This eliminates any obstructions to mopping and servicing. The tile or terazzo floor is sealed and sloped to a central drain, thus speeding up the cleaning process and increasing the usable time of the installation. Lighting fixtures are recessed in the ceiling, requiring less frequent cleaning than fixtures which hang from the ceiling or extend from walls.

A modern lavatory of either vitreous china or enameled cast iron is not only a better looking fixture than its predecessors, but is easier to keep clean and is more durable. It is desirable to have lavatories equipped with "pop-up" waste valves, for plugs are either carried off or lost in many cases.

In plants where large groups of people are likely to be washing at the same time, wash fountains which permit 8 to 10 people to wash at the same time may be installed. Wash fountains can be kept clean with a minimum of janitor labor and are economical in the use of water.

Some industries have wash fountains in or near locker rooms to care for the "rush hour" business at the end of a shift or at closing time. Lavatories are usually installed in the same room as the water closets for convenience.

Wall hung type closets are recommended for all factories and plants for the ease in which they permit the floor to be cleaned around them. Closets should be of the extended lip type with open front seats preferably made of durable composition or rubber material. Composition seats have the dual advantage of standing abuse as well as not being harmed by the use of strong disinfectants. The pur-

Fig. 1. A wash fountain installation has been found to be practical in plants where large groups of people are apt to be washing at the same time. Wash fountains are easily maintained and are economical in the use of water

Fig. 2. A practical design for industrial use is the long, oval rim closet equipped with an open front seat of either hard rubber or composition material. The flushing mechanism should be equipped with a vacuum breaker

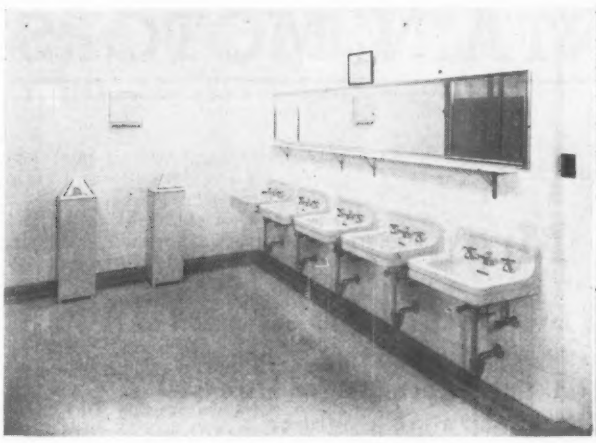


Fig. 3. Individual lavatories with a well-lighted mirror and shelf are popular with women workers in an industrial plant. Note that the spouts of the faucets are slanted upwards at least two inches above the rim of the bowl to prevent back-siphonage of the waste water into the pure water supply

Fig. 4. These vitreous china urinals have adjustable flush valves in a tank of porcelain enamel on cast iron. The flushing tank operates on an average of twelve times per hour each. Installed with the floor sloping toward them, urinals of this type do away with the necessity for another drain

chase of a good grade seat is a wise investment, for it will never need repairs, and can be easily kept clean and in perfect condition.

Ease of Cleaning

Closet seats can be cleaned with soap and water or a disinfectant may be used, if necessary. All the janitor has to do is hose them off with hot water or steam, or any other method that is fast, thorough, and easy.

Doors are sometimes omitted on the closet stalls in the men's room, thus making it possible to narrow the stall in width and depth. The stalls in the women's room, however, should always be provided with doors.

Few conditions give rise to such vehement complaints as closets which cannot be flushed either because of lack of water or on account of disrepair of the flushing mechanism.

Some master plumbers advise placing the handles on concealed flushing valves high enough so that employees cannot kick the handles with their feet when flushing. Should foot action be preferred, select the valve so equipped. Some city plumbing codes require that flush valves be placed not less than 10 in. above the rim of the bowl to minimize the chance of back siphonage. Also in order to guard against the possibility of back siphonage, it is desirable to equip flush valves with vacuum breakers.

Important Factors

In the selection of water closets and urinals, the most important requirements are durability, ease in cleaning, and dependable operation. The siphon jet closet with elongated bowl and open front hard rubber seat is the most practical for industrial installations.

Urinals of vitreous china are preferable in men's washrooms because this material will not become stained under normal usage, and is easily kept in a clean, sanitary condition. They may be of the wall or stall type, and may be individually equipped with hand-operated flush valves or with adjustable automatic flush valves in a tank or porcelain enamel or vitreous china.

Some industrial plants prefer urinals equipped with a flushing tank which operates automatically at predetermined intervals or on an average of twelve times per hour each. While this type of flushing guarantees a periodic sanitary cleansing of the fixtures, some believe that the hand-operated flush valve is much more practical for plant use because of the saving of water incurred.

When floor-type urinals are used, it is economical to have them installed with the floor sloping toward them. Thus excess water in scrubbing the floor, etc., drains into the urinals, and this does away with the necessity for other drains.

Shower baths are becoming an increasingly important part of the sanitary facilities of today's places of employment, particularly in such dusty operations as flour milling, foundry work, and mining.

The modern midget shower head is only about two and one half inches or less in diameter. It concentrates the water on the bather and may be adjusted to give a stream of varying intensity. These showerheads are practically non-clogging and easy to clean.

Safety from scalding is an important precaution and the use of temperature controllers should be seriously considered. These prevent sudden surges, from shower heads, of hot water, which might seriously burn an employe and incapacitate him for a long period of time.

A plentiful supply of drinking water of known purity should be made accessible to all employees through the installation of approved drinking fountains. Water should be filtered if necessary; should be examined periodically for chemical and bacterial impurities; and where practicable, a central refrigerating plant and circulating water system should be provided so that drinking water will be delivered at the fountains at a temperature ranging from 45 F to 60 F. Individual cooling tanks may be used where it is impossible or undesirable to install a circulating system.

Water should come out of a fountain in a slant stream from a pro-

(Continued on page 51)

Fig. 5. A plentiful supply of drinking water should be easily accessible to all employees. Shown here is an inexpensive type of vitreous china drinking fountain with non-squirt, angle stream jet and self-closing valve

HOW TO MAINTAIN MOTORS

By C. G. GRANT,

Motor Division, General Electric Co., Schenectady, N. Y.

I—Preventive Maintenance

What to inspect . . . What to inspect for . . . How often to inspect . . . What to look for in weekly, monthly, seasonal and yearly inspections . . . Instruments needed for inspection and maintenance . . . Preventive maintenance . . . Devising a system of scheduled equipment inspection

MOTORS AND GENERATORS, like most industrial equipment, do not require meticulous care for efficient operation.

There are two clearly defined courses motor users may follow: No maintenance until a stoppage forces action, or, secondly, regular, planned maintenance designed to keep equipment running for many years. Of the two, the latter has proved to be the best from the standpoint of pure economics in addition to the fact that it offers the advantage of smoother, over-all factory performance. Time being a very important factor in today's production picture, motor and generator stoppages cost heavily, and a reasonable expenditure aimed at reducing these losses can usually be more than justified.

This article and others to follow, is designed to acquaint the maintenance man with the general procedures, records, and troubles encountered in a maintenance department. For specific details concerning the operation or adjustment of a motor or generator, refer to the manufacturer's instructions which are usually supplied with each piece of rotating equipment.

Any maintenance plan, to be effective, should include consideration of the following principles:

1. Schedule regular inspections of motors and generators.
2. Maintain a stock of parts, units, and assemblies so that quick changes may be made.
3. Spare parts should be properly binned and kept in good condition for quick application.
4. Keep records of troubles and "cures" and maintenance performed for each piece of equipment.
5. Check new installations, or motors with new parts, as soon as they are placed in operation.
6. Utilize maintenance personnel properly trained for the job.
7. Check periodically the load on each piece of equipment to prevent overloads or wasteful underloading.

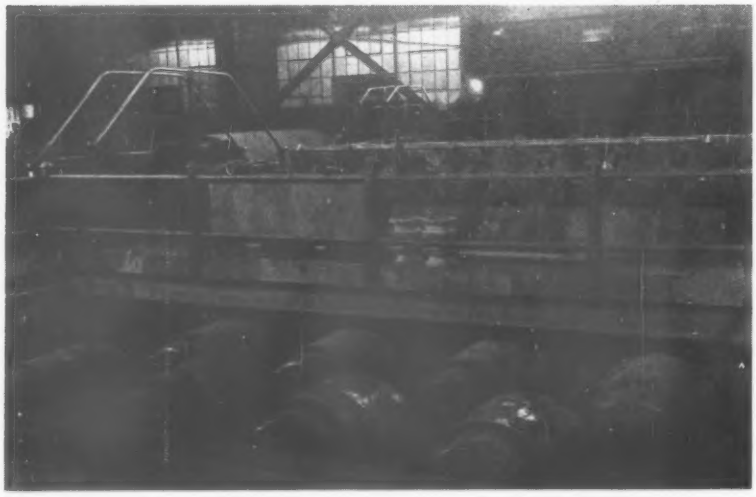


Fig. 1. Note that these motors are clean despite the fact that they are in a steel mill, where the atmosphere is invariably dusty

The problem of maintenance depends to a great extent on the application of each motor or generator. Severe applications are frequently unavoidable. In such cases, these machines should receive extra maintenance. The suggestions which follow are of necessity for average conditions, and the time schedules shown should be modified for special conditions.

Maintenance Rules

It is indeed fortunate that motors and generators have many elements which are common in design and for which maintenance is fairly uniform. Such items as insulated windings, brushes, collector rings, commutators, and bearings are for this reason treated independently of the machines in which they are used. The same is true of disassembling and assembling, and external inspection.

These simple rules will add years to the life of your motor or generator:

Keep it clean.

Keep it properly lubricated.

Inspect it regularly.

Know the condition of your machine at all times.

Correct weak points before the motor fails.

Take care of your motor so that it, in turn, can take care of its job. (Fig. 1).

Maintenance Records

Indexed service records should be kept on each motor and generator to insure scheduled inspection. Several such systems are in use, among the most successful being the service record card. A typical card is illustrated in Fig. 2. This should be filled out at the time the motor is acquired, and notations of all servicing and repairs can be made at the time work is performed by the maintenance man, thereby cutting clerical work to a minimum.

Maintenance records are also a great aid in locating chronic troubles and progressive deterioration, which

can then be remedied before costly repairs are necessary.

Cost of maintenance as a whole, as well as on individual operations, can readily be determined for such activities as cost reduction studies and personnel requirements. Inspection records also serve as a guide to tell when a motor should be replaced because of the high cost of keeping it in operation. Misapplied motors will also be discovered through these records.

Renewal parts stocks can be estimated more closely by close examination and proper interpretation of motor service records.

A recommended supplement to this service record card is a file containing necessary blue prints and instruction books cataloged for immediate reference.

Many maintenance organizations also find it advisable to maintain a "locator" board which shows the location of each motor at all times. In this manner, the number of motors in storage, in service, and in repair can be determined instantly.

Maintenance Personnel

The time has long since passed when just anyone could maintain a motor. Efficient operation of a maintenance department demands that its personnel be thoroughly trained for their job. Such training enables a maintenance man to interpret intelligently what he sees and hears, and what action should be taken.

Many large maintenance organizations train their own men, while others rely on men with outside training. The principal factor to remember is that these men should be trained to know the equipment on which they work. It will pay dividends in the form of less equipment trouble and lost production time.

Experience has also proved the advisability of fixing the responsibilities for each maintenance man. Such a system promotes pride in work and an aggressive attitude toward doing a good job.

Instruments Needed for Maintenance

The number of instruments which can be used for maintenance is almost infinite, however the number required for practical use can be restricted to a reasonable investment by making a careful choice. Large plants utilizing many motors naturally will require many sizes and types of instruments, while the small plant with few motors may not be able to afford an elaborate outlay of equipment. A few well-chosen instruments will pay for themselves many times over (Fig. 3 & 4). A basic list of instruments which are considered necessary for even the

H.P.	Syn. Speed	Make	Connection Diagram	Application	Shop or Mill No.	Card No.

Type	Frame	Poles	F. L. Speed	Volts	Form	Temp. Rating	F.L. Amp.	Phase	Cycles

Serial No.
Model No.

Publication No.

CONTROL EQUIPMENT

Type	Make	Pub. No.

BRUSHES
No. Per Motor
Cat. No.
Size
Material
Grade

COILS
(Cat. or Spec. No.)
Stator or Field
Main
Comm.
Comp.
Rotor or Armature
Coils
Bars
No. per Set

LININGS
Front End, Cat. No.
Pulley End, Cat. No.

Connection Diagram

PULLEY
Diam.
Face
Belt Width
Bore
Keyway

Mfr's Order No.
Our Order No.
Date of Order
Cost { Motor / Control

User:
Location:

SERVICE RECORD

Date	Building	Floor	Driving	Drive	Tested Hp.

REPAIRS

Date	Condition	Due to	Repaired by	Cost

Fig. 2. Proper record cards add much to the value of inspection. This is a sample of a good record card

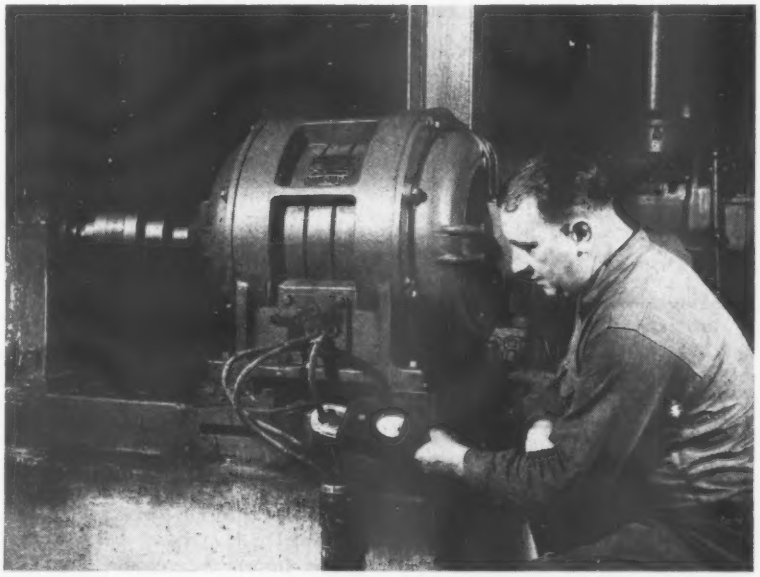


Fig. 3. Line voltage or current can easily be measured with a hook-on voltammeter. Readings give indications of line-voltage drop or motor overloads

Fig. 4. (Left) G. E. hand tachometer being used to measure speed of motor

Fig. 5. (Above) Although this motor is operating satisfactorily, dirt and dust such as this should not have been permitted to accumulate on it since overheating might result

small plant with few motors is shown in the preferred list which follows:

PREFERRED LIST: (Range and type to suit plant equipment)
Portable indicating voltmeter.
Portable ammeter.
Megohmmeter.
Hand-revolution counter.
Thermometers (centigrade).
Various leads with insulated clips and points.

For the plant with a large number of motors, the following supplementary list will aid maintenance men in performing their duties more quickly and efficiently.

SUPPLEMENTARY LIST: (Number, types and ranges to suit plant).
Portable recording voltmeter.
Portable recording ammeter.
Hand tachometer, indicating.
Hook on voltmeter—ammeter.
Phase-rotation indicator.
Growler.
Millivoltmeter.

Preventative Maintenance Schedule

Intelligent and thorough inspection will reveal sources of future troubles and correct them before expensive repairs are necessary.

To accomplish this fact, a system of scheduled inspection should be established. It will, of course, vary with the type of motor, its applications, percentage of the day it operates, and its importance to the whole plant production scheme. Therefore, the following is only a typical schedule which has been used with success and is based on average conditions insofar as dust and dirt are concerned. Such a schedule can be kept along with the lubrication schedule or as a separate program, whichever is more convenient.

SPECIAL INSPECTIONS

Motors should be given inspection equal to the weekly inspection a few hours after being put in operation, either as a new motor or as a repaired motor.

WEEKLY

WHAT TO INSPECT	WHAT TO INSPECT FOR
Surroundings (Fig. 5)	Note any dripping water, acid, or alcohol fumes; also, any unusual amount of dust, chips, or lint on, or about, the motor. See if any boards, covers, canvas, etc., are left about that might interfere with ventilation or jam moving parts.
Sleeve-bearing motors—ring-lubricated, wool-packed, etc.	Where an oil gage is used, check the oil level and if necessary fill to the line on the gage. When the journal size is less than approximately two inches, stop the motor to check the level. For special lubricating systems, such as wool-packed, forced lubrication, flood and disk lubrication, refer to instruction book. Add oil to bearing housing, if need is apparent, only when motor is stopped. See if oil is creeping along shaft toward windings. If it is, report the condition.
Mechanical condition	Motor distress will often show up in unusual noise caused by metal-to-metal contact or in odor from scorching insulation varnish or abnormal vibration. Report at once for further inspection as soon as motor can be stopped.
Ball or roller bearings	Feel bearing housings for evidence of vibration, and listen for any unusual noise. Inspect for creepage of grease on inside of motor or generator.
Brushes and commutators or rings	Looking for sparking. If on cycle duty, watch through several cycles. Note color and surface condition of commutator.

	Don't neglect any brush. Check all brushes for remaining wear. Check pig-tail connection for looseness.
	Inspect for black spots or roughness developing on commutators or rings. Clean surfaces with a commutator cleaning stick.
Rotors and armatures	Check air gap on sleeve-bearing motors, especially if recently overhauled. If new bearings have been installed, make sure that the average air gap is within 10 per cent, if air gap is normally less than 20 mils (0.020 in.). See if air passages, through punchings, are becoming clogged with any foreign matter.
Windings	If needed, clean by suction or mild blowing.
	Make sure machine is dead mechanically and electrically. Wipe off dust with dry cloth. Note evidence of moisture. See if any water has accumulated in bottom of frame. See if any oil or grease has worked its way up to the rotor or armature windings. Clean with carbon tetrachloride in a well ventilated room.
Mechanical inspection	Check belt for suitable slack and surface condition. Look at gears for signs of uneven wear. If flexible couplings are properly lined up, there will be no noise or evidence of excessive use of the flexible factor. See if chains clear housings. Check chain lubrication, especially for excess grease and oil in bottom of housing. See if sprockets show even wear across the teeth. Check motor starting to see that it comes up to proper speed each time power is applied, check to be sure mounting bolts are tight. Report abnormal action for control checkup.

EVERY 1 OR 2 MONTHS

Windings	Check shunt, series, and commutating fields for tightness.
	Try to move field spools on the poles; drying out may cause some play. If this condition exists, refer to the nearest service shop.
	Check machine cable connections for tightness.
Brushes, a-c and d-c	Check brushes in holders for fit and free play. Check brush-spring pressure.
	Tighten brush studs to take up slack from drying out of washers. Be sure studs are not displaced on d-c units.
	Replace brushes that are worn down almost to the brush rivet.
	Examine brush faces for chipped toes or heels, and for heat cracks. Replace any that are damaged.
Commutators	Examine commutator surface for high bars and high mica, or evidence of scratches or roughness. See that risers are clean and have not been damaged in any way.
Ball or roller bearings	On hard-driven, 24-hr service motors, purge out old grease through drain hole and apply new grease.
	Check to make sure grease or oil is not leaking out of the bearing housing. If any leakage is present, correct the condition before continuing to operate.
Sleeve bearings	Look for bearing wear, including end-play bearing surfaces.
	Clean out oil wells if there is evidence of dirt or sludge. Flush with lighter oil before refilling.
Enclosed gears	Open drain plug and check oil flow for presence of metal scale, sand or water. If condition of oil is bad, drain, flush, and refill as directed. Rock rotor to see if slack or backlash is increasing (see previous service record).
Couplings and other drive details	Note if belt-tightening adjustment is all used up. Shorten belt if this condition exists. See if belt runs steadily and close to motor edge of pulley. Chain should be checked for evidence of wear and stretch. Clean inside of chain housing. Check chain-lubricating system. Note incline of slanting base to make sure it does not cause oil rings to rub on housing.
Loads	Check loads for changed conditions, bad adjustment, poor handling or control trouble.

BY SEASONS—up to two years

Windings	Check insulation resistance. Check insulation surfaces for dry cracks and other evidence of need for coatings of insulating material. Clean surfaces and ventilation passages thoroughly if inspection shows accumulations of dust.
	Check moisture, mold or water standing in motors, to see if varnishing and baking are needed after drying out windings.
Air gap and bearings	Check air gap to make sure that the average reading is within 10 per cent, provided the reading should be less than 20 mils or 0.020 in. All bearings, ball, roller and sleeve should be thoroughly checked, and defective ones replaced. Waste-packed and wick-oiled bearings should have waste or wicks renewed, if they have become glazed or filled with metal or dirt. See that new waste bears well against shaft.

Rotors (squirrel-cage)	Check for broken or loose bars and evidence of local heating. If fan blades are not cast in place, check for loose blades. Look for marks on surface indicating foreign matter in air gap, or worn bearing.
Rotors (wound)	Clean thoroughly around the collector rings, washers, and connections. Tighten connections if necessary. If rings are rough, spotted or eccentric, refer to a service shop for refinishing. See that all top sticks or wedges are tight. If any are loose, refer to a service shop.
Armatures	Clean thoroughly all air passages if any are obstructed. Look for oil or grease creepage along shaft, checking back to bearing. Check commutator for surface condition, high bars, high mica, or eccentricity. If necessary to turn the commutator.
Mechanical parts	Check belt or chain for possible need of replacement. Do not wait for them to break during production rush. Clean inside and outside of frames and end bells. Turn rotor by hand to locate misalignment, sprung shaft or rubbing. If motor is connected to a machine check by turning both with lever to see if the machine imposes an excessive friction load.
Loads	Read load on motor with instruments at no load, full load, or through cycle—as check on mechanical conditions of the driven machine.

How to Choose the Right Valve and Install It

THE FIRST important consideration when specifying valves is to select the right valve. Long life, satisfactory performance and low maintenance depend upon fitting the valve to the job. Any user of valves, therefore, will do well to take seriously the following hints on the care and installation of valves prepared by the engineers of The Wm. Powell Co.

Whether a valve is suitable for a particular job is determined by its design and the materials of which it is made. There are four basic types of valves—Globe, Angle, Check, and Gate.

The materials most commonly used in valve construction are Bronze, Iron and Steel. Valves for special service where they must be corrosion resistant are made of special alloys or of pure metals such as silver, nickel, etc. Among the commonly used alloys are stainless steel alloys, aluminum, aluminum bronze, acid bronzes, Monel metal, Inconel, Everdur, Herculoy, Chromium iron, and others.

To be sure of selecting the right valve and obtaining best results, it is necessary to know the kind of media and the amount of flow to be handled, the pressure, temperature, nature of service, the physical conditions at points where valves are to be installed and the frequency of operation.

Choosing the right metal means good service. Ordinarily bronze valves, in sizes up to 3 in. are suitable for steam pressures of 125 psi at 500 F, 150 psi at 500 F, 200 psi at 500 F, 300 psi at 550 F, and 350 psi at 550 F. Iron valves are suitable for steam pressures of 125 psi at 450 F, 175 psi at 450 F, and 250 psi at 450 F; while for higher pressures and temperatures steel valves should be used.

In processes where highly corrosive and erosive media are encountered only valves made of pure metal and special alloys should be considered. If there is any doubt as to what materials to use for best results, consult the manufacturers of the valves.

When valves are to be stored before installation, keep them wrapped and protected as shipped by the manufacturer. If they are unprotected and left exposed, sand or other gritty matter may get into the working parts, and, if not thoroughly cleaned out will cause trouble later on. Also store valves so they cannot fall or where other heavy materials cannot fall upon them. Great care should always be exercised in handling valves.

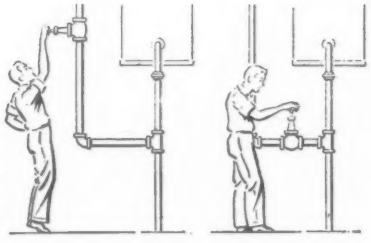


Fig. 2. Where possible valves should be located where they can easily be reached

Before installation the inside of the valves should be blown out with compressed air or flushed with water to remove all dirt and grit. Piping should be cleaned out in the same manner or it should be swabbed to remove dirt or metal chips left from

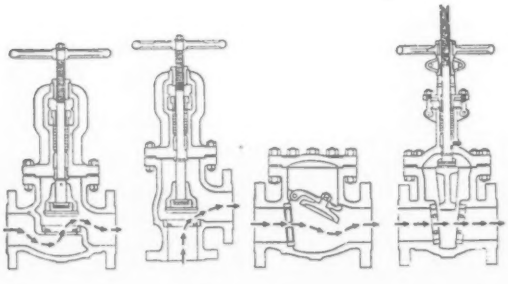


Fig. 1. Here are shown the four basic types of valves; from left to right: globe, angle, check and gate

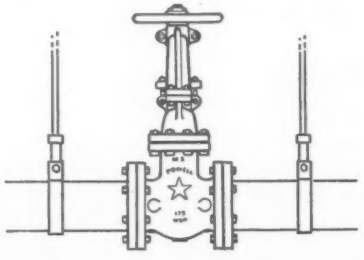


Fig. 3. It is good practice to support the line on each side of the valve

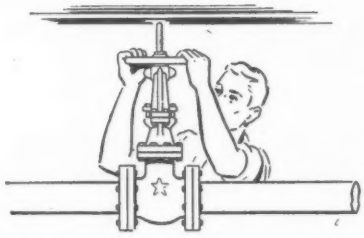


Fig. 4. Where rising stem valves are installed plenty of clearance must be provided so they can be fully opened

threading operations on the pipe.

Valves should be conveniently located on the line so they can be easily and safely reached and so the operator can exert just the right amount of force to open or close them properly. When installed at fingertip height, rather than to get something to stand upon, the operator will usually try to stretch just enough to reach the hand wheel. In this position he cannot close the valve tightly and eventually leaks develop. While it is always better to install valves with the stem upright, they can be mounted in the line with the stem at any angle. However, when installed with the stem in a downward position, the bonnet is under the line of flow forming a pocket to catch and hold any foreign matter that will eventually cut and ruin the inside stem threads.

Keep pipe strains off valves. Don't let the valves carry the weight of the line. The distortion from this cause results in inefficient operation, jamming and early maintenance. It also makes it difficult to tighten the flanges properly. Piping should be suspended from hangers placed on each side of the valve to take up the weight.

When installing rising stem valves, be sure to allow sufficient clearance to remove stem and bonnet if necessary. Insufficient clearance prevents valve from being fully opened and results in excessive pressure drop, gate bridge erosion, and chatter, wire drawing or seat wear.

When installing screwed end valves, always use the proper size wrenches with flat jaws (not pipe wrenches). By so doing there is less likelihood of the valve being distorted or damaged. Also the wrench should be used on the pipe side of the valve to minimize the chances of distorting the valve body. This is important where the valve is made of malleable material such as bronze. As a further precaution against distortion see that the valve is closed tightly before it is installed.

Avoid undersize threads on pipe. If the threaded section of the pipe is too small the pipe when screwed into the valve to make a tight connection, may strike the diaphragm and distort it so that the disc or wedge will not seat perfectly. Under size threads on the pipe also may make it impossible to make a tight joint. Safe practice is to cut threads to standard dimensions and standard tolerances. All pipe threads in valve bodies are gaged to standard tolerances.

On flanged valves and fittings the flange bolts should be tightened by pulling down the nuts diametrically opposite each other and in the order as numbered, see Fig. 6. All bolts should be pulled down gradually to a uniform tightness. Uniform stress across the entire cross section of the flange eliminates a leaky gasket.

Paint, grease, or joint sealing compound should be applied only to the pipe (male) threads, not on the threads in the valve body. This reduces the chances of the paint, grease, or compound getting on the valve seat or other inner working parts of the valve to cause future trouble.

Where quick opening or closing valves are installed on liquid lines, severe water hammer or shock may result when the valve is opened or closed quickly. The resulting sudden back-lash or surge of pressure causes pounding and vibration in the line which eventually ruins the valve and weakens the pipe joints in the system. Usually a vertical capped stand pipe a few feet long and located not too far from the valve will tend to absorb the reverberating pressures, see Fig. 7.

Long runs of rigidly supported piping carrying high temperature fluids should be joined with an expansion joint having sufficient traverse to more than take up the expanson of the length of pipe involved. This kind of installation protects valves and fittings.

Frequently on large size high-pressure high-temperature steam lines or lines carrying hazardous media a U bend in the line serves the same purpose.

A few drops of oil or oil and graphite now and then on the stem above the packing, will keep the stem and packing lubricated, eliminating frictional wear between the stem and packing.

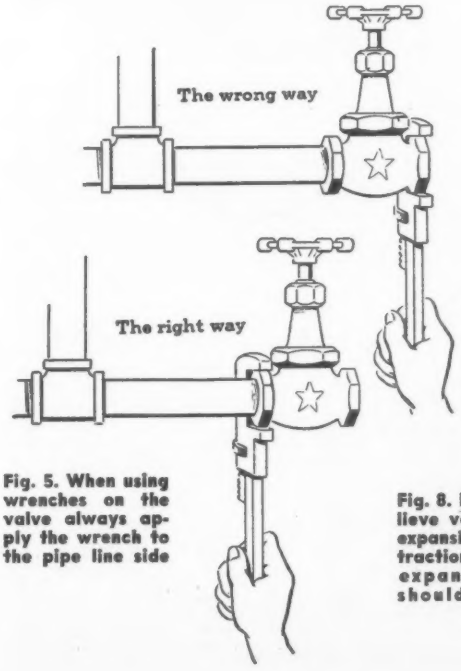


Fig. 5. When using wrenches on the valve always apply the wrench to the pipe line side

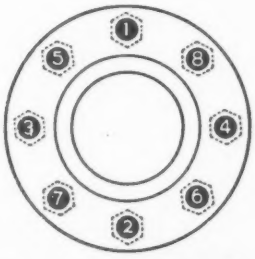


Fig. 6. This drawing shows the order in which the flange bolts should be pulled

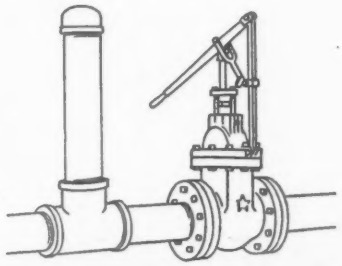


Fig. 7. A capped standpipe installed in the line in front of the valve eliminates some of the causes of water hammer

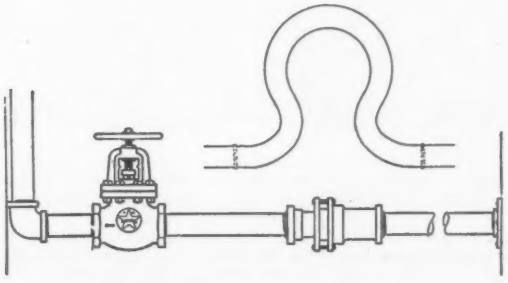


Fig. 8. In order to relieve valves of much expansion and contraction strain a "U" expansion bend should be installed

How to Figure Costs of Painting Steel Water Tanks

By JOHN M. PERRYMAN
Contracting Engineer, R. D. Cole Mfg. Co.

Regular annual inspection, proper repairs, preparation of surfaces . . . Good paint is good economy . . . If cathodic protection is used, proper paint will increase its effectiveness . . . How to estimate paint requirements . . . Cost of painting with and without cathodic protection . . . Costs of interior bituminous tank coatings

STEEL water tanks and towers should receive careful annual inspections and not suffer from neglect. From the time metal is removed from its ore, it strives to return to its original form. Due to varied uses and conditions, all metals are subject to rust and corrosion.

Paint has been and still is the proved method for the protection of steel, although, as a result of research and experience, other methods are being used. Therefore they are being mentioned for your consideration and guidance.

Even the best paints will not adhere to rusty steel unless the steel has been properly cleaned of all loose rust, grease and old, loose, paint.

Good Paint Is Good Economy

Most metal-protective paint tests are carried out to determine weather resistance. However, the paint's ability to remain continuous and unbroken, thereby shutting out air and moisture, is believed not to be the full measure of its effectiveness as a metal protective coating. In addition to purely physical protection, some paints protect chemically. As a result of their chemical make-up, they actually inhibit corrosion. This explains why, between two paints of equal durability, one often proves to be a far more effective rust-preventative than the other.

Good paint is good economy. Since labor is the governing factor in the cost of painting, amounting to approximately 80 per cent of the total cost, the use of the better grades of paint adds little to the final cost.

A fact to remember is to repair before painting, so it is desirable that you secure the advice of experts be-

Fig. 1. Typical elevated steel water tank, 150,000 gal capacity on 100-ft tower. Oval bottom and top. Cathodic protection equipment installed in tank. This tank serves City of Newberry, S. C.

Fig. 2—Right. Dual service railroad tanks for Diesel engine service, installed at New Smyrna, Fla. Upper tank, 25,000 gal water. Lower tank, 15,000 gal oil

fore proceeding with your painting. When experts are mentioned, do not be misled by false or misleading statements. Remember: the loads involved in water tanks of the elevated type are highly concentrated. The advice of so-called "steeple-jacks," who are not professional engineers, cannot therefore be relied upon. Usually they do not have knowledge of the stresses or the methods of calculating stresses to advise you fully as to the strength or weakness in a tank. It is suggested, therefore, that you ask for credentials or other evidence of any one's ability to pass judgment on tank detail. **This is highly important.**

Furthermore, before entering into a contract, be certain that all work to be done has been agreed upon in writing, and that no hidden clauses in the contract entitle the person or persons doing the repair work to proceed with additional repairs or replacements without written advice and predetermination of cost.

Estimating Paint Requirements

Now let us consider quantity of paint involved to properly paint your tank. Table 1 gives the average quantity of paint required, and I believe that this is fully self-explanatory. This Table is for the reader's guidance and should take care of all popular sizes of elevated steel water tanks.

SAMPLE ESTIMATE:—Referring to Table 1, secure therefrom the amount of paint required for your tank, and then total the approximate cost as follows:

Take, for example a 100,000-gal. elevated tank together with a steel tower 100-ft high and a 3-ft diameter steel riser. Calculate as follows:

1—Inside red lead (15 gal) @ $5.00	$ 75.00
2—Inside black paint (15 gal) @ $4.00	60.00
3—Outside red lead (5 gal) @ $5.00	25.00
4—Outside aluminum (40 gal) @ $5.00	200.00
Total for materials	$ 360.00
Add for labor and incidental cost, four and one-half times the cost of paint	$1,620.00
Total cost including a nominal amount of wire brushing, both inside and outside, replacing manhole gaskets, and stopping any small leaks (not to exceed 10), total cost	$1,980.00

When Using Cathodic Protection

It is recommended that the tank be painted on the inside below and above the water line when using cathodic protection, for the condition of the submerged steel surface is of utmost importance and the initial cost of cathodic protection units are determined by the condition of the tank, as well as by the kind of water that is being handled.

It is recommended that, on both old and new tank installations, the inside of the tank and riser be painted with two coats of red lead paint or its equivalent, prior to installation of cathodic protection. Therefore the Sample Estimate shown above would apply, plus the cost of cathodic protection to give the best results.

Table I. Gallons of paint required for steel water tanks of various capacities, based on 100-ft towers

	50,000 Gallons	75,000 Gallons	100,000 Gallons	150,000 Gallons	250,000 Gallons	500,000 Gallons
First Coat Inside	8	10	12	15	25	50
First Coat Outside	12	14	17	22	35	70
Second Coat Outside	12	14	17	22	35	70
*Riser, Per Coat	3	3	3	3	3	3

*Note: The 3-gal requirement is for 3 ft diameter risers. For 4 ft diameter riser, add 3 gal. For 5-ft riser, add 6 gal per coat.

Table II. Approximate cost of cathodic protection for steel water tanks of various capacities

Approximate cost of Cathodic Protection, not including cost of cleaning or painting the inside of tank, nor painting the underside of the roof and top shell ring:	
50,000 gal tank	$ 800.
100,000 gal tank	900.
250,000 gal tank	1200.
500,000 gal tank	1600.
Cost of painting underside of roof and top shell ring:	
50,000 gal tank	$ 300.
100,000 gal tank	350.
250,000 gal tank	500.
500,000 gal tank	700.

For costs of cathodic protection, see Table II. Then calculate the total cost by the following method:

For underside of roof:	
Inside red lead (5 gal) @ $5.00	$ 25.00
Inside black paint (5 gal) @ $4.00	20.00
Four and one-half times materials for labor	200.00
Scaffold	100.00
Cathodic unit installed (see Table II)	900.00
Total for 100,000-gal tank	$1,245.00
To the above add the cost of the outside painting (see first example—Paints for outside—(40-gal) @ $5.00	$ 200.00
Four and one-half times material for labor	900.00
Total cost of painting outside	$1,100.00
Cost of painting underside of roof and installing cathodic protection on inside	$1,245.00
Total cost	$2,345.00

Another method of protecting the inside, is by the use of two coats of

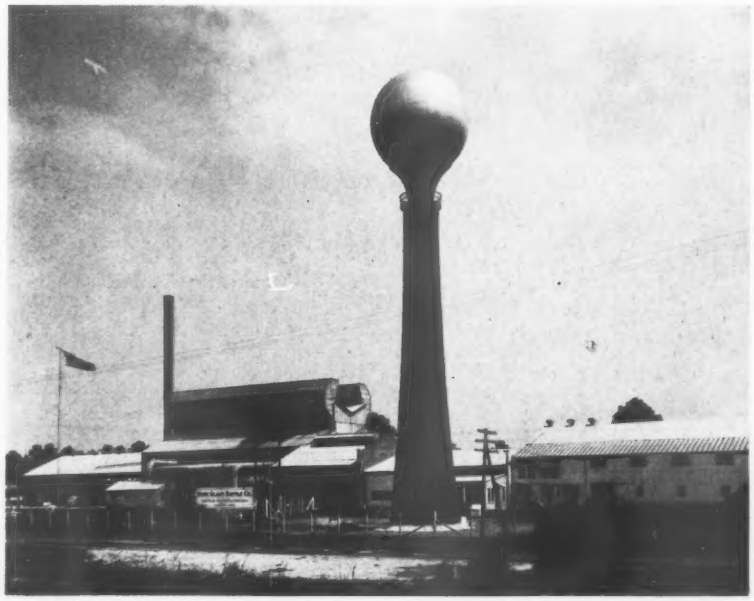


Fig. 3. Dual service water tank at Knox Glass Bottle Co., Jackson, Miss. Spherical tank, 75,000 gal capacity, for sprinkler service. In tower, 90,000 gal capacity for domestic service

Table III. Approximate cost of bituminous solutions for protecting steel water tanks of various capacities

Approximate cost applying one coat Bituminous Solution and two hand brushed coats of Bituminous Enamel to riser, bottom and shell and two coats Bituminous Solution to underside of roof:

50,000 gal tank—3 ft riser	$1500.
100,000 gal tank—3 ft riser	1800.
250,000 gal tank—4 ft riser	2850.
500,000 gal tank—5 ft riser	4250.

bituminous interior tank coating on the inside of the riser, the bottom and the shell of the tank, and painting the underside of the roof two coats of bituminous solution.

The approximate cost of doing this work on a 100,000-gal tank is approximately $1800 for applying on the inside as shown in Table III and the cost of painting the outside of the tank is $1,225, making a total cost of $3,025.

Items Not Included

In using the above estimates, remember that excessive cleaning, repairs and replacements are not included in the estimates of cost outlined. Nor does the information given outline the advantages or peculiarities of any of the principal methods of giving protection to your tank; nor do they include estimates of life expectancy or protection, upkeep or operating devices and operating cost of the electrical protective devices.

How to Use Paint to Control Heat

By RALPH W. EMMERSON,
National Paint, Varnish and Lacquer Association

Correct selection of paint color reduces temperature in buildings and cuts evaporation losses in tanks containing volatile liquids . . . Humidity can be controlled . . . Right choice of paint pigment will aid radiation . . . Insulating effect . . . Psychological effects of color

HEAT CONTROL is a relatively new discovery. The explorer, Amundsen, reporting on his experiences in the Antarctic, tells of what seemed to be a kind of phenomenon when three paddles of different colors were left on the surface of the snow. After considerable exposure, it was found that the darkest colored paddle had sunk rather deeply into the snow, while a second paddle of a medium color had also settled into the snow, but not so deeply as the darker, but a white paddle remained on top of the snow without sinking. There is no longer any "mystery" about why this happened, for extensive experiments and demonstrations by the Scientific Section of the National Paint, Varnish and Lacquer Association in Washington, D. C., and by the United States Bureau of Standards, have proved beyond question the cooling and heating effects of colors.

In one of the pioneer experiments holes were bored in red bricks which were unpainted, and in bricks which had been painted white. Thermometers were inserted in the cavities of the bricks which were placed side by side in direct sunlight. When the thermometers were inspected, it was found that the difference in temperature inside of the two bricks was distinctly different. This led to experiments on a much larger scale, with the result that it was thoroughly demonstrated that a brick building with its exterior painted white reflects so much heat in direct sunlight that its surface is approximately 14 deg cooler than the surface of natural brick correspondingly exposed.

Paint, regardless of the color, seals the surface of the brick and prevents saturation of the wall by rain through the mortar joints and keeps the wall dry and to an important degree insulated. Moisture is a very rapid conductor of heat or cold.

Insulating Effect

The heat reflective power of white paint is operative in direct sunlight and only to a relatively negligible degree on cloudy days, and not in darkness. In the winter season, in the colder parts of the country, there is a much lower incidence of sunlight in winter than in summer, and the hours of darkness are much longer in winter than in summer. Consequently, while white paint cools a building in summer, it has little, if any, effect of that kind in winter, and the insulation provided by the paint may even keep the building warmer in winter than it would be if it were left unpainted.

George D. Gaw, Director of the Color Research Institute, a nationally known expert on color, in an article in "Coronet" magazine, on "The Power of Color" included this illuminating example:

"When the Belgian scientists and famous twins, Auguste and Jean Piccard, made their first flight into the stratosphere in 1931, they painted their gondola white. It gathered ice and they nearly froze to death. On the second trip upward in 1932, they painted the gondola black, and they almost burned up. Later two American Marine officers flew into the stratosphere with half of the gondola painted light and the other half dark, and they rode in comfort—it was cool where they breathed and warm about their feet."

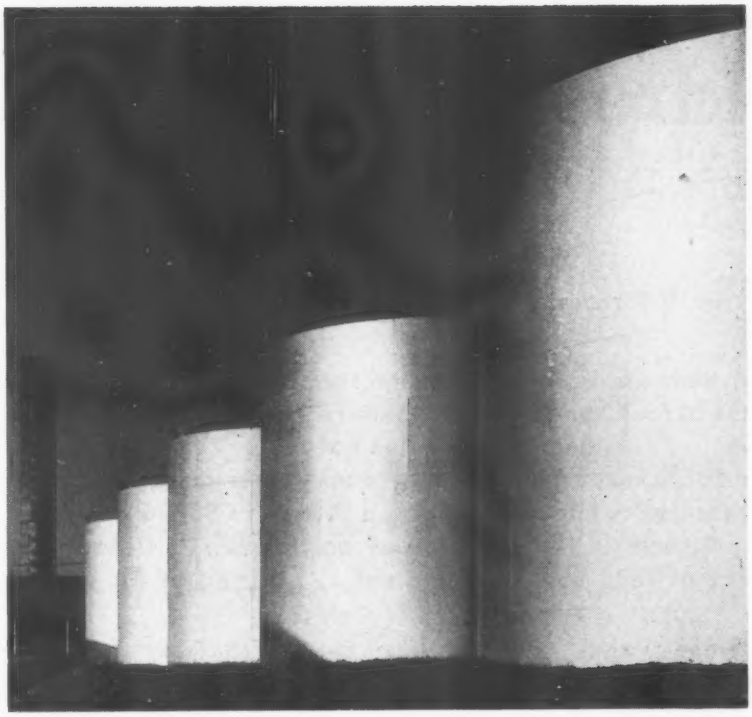
Paint for Humidity Control

The degree of control of humidity by the use of paint was demonstrated in two test buildings, one painted white and the other unpainted, both built of brick, by the Scientific Section of the National Paint, Varnish and Lacquer Association. The chart from the painted building showed a constant relative humidity in the test room, indicating little or no influence of moisture conducted through the walls, whereas the unpainted building chart showed a variation of about 15 deg relative humidity.

The National Bureau of Standards in a comparative test of daily mean rise of temperature of test panels in different colors exposed to the sun reported a range from 8.9 deg F for glossy white paint to 20.9 deg for black paint—a difference of 12 deg. It was found that some unpainted roofing materials were heated almost as hot as the black panel, and in the case of one red roofing material, 21.5 deg or 0.6 per cent more. Flat white paint was a close second to glossy white in coolness, the difference between the two types of white being only .2 deg F. Ivory paint showed a rise of 10.2 deg; canary yellow, 10.9 deg; pearl gray, 13.3 deg; silver gray, 13.9 deg; light lead colored paint, 15.1 deg; slate colored paint, 16.8 deg; and medium green (trim color), 20.4 deg; or almost as much as black.

TABLE I

Tank Covering	Evaporation Losses Gallons	Evaporation Losses Per Cent	Loss in Gravity A. P. I.
White paint	112	1.40	0.45
Aluminum foil	170	2.12	0.55
Aluminum paint	187	2.34	0.62
Red paint	284	3.54	0.89



Perhaps the most spectacular example of this phase of paints' usefulness is to be found in its use on gasoline storage tanks. The contents of a tank are naturally affected by the heat of the sun which shines on the structure. Some loss of gasoline due to evaporation will occur when the temperature within the tank rises sufficiently. In a U. S. Bureau of Mines investigation into this subject, the results shown in Table I were noted.

Radiation Effect of Paint

The painting of radiators is an outstanding example of the functional use of paint inside buildings. Radiators painted white or other light colors radiate heat while metallic paints tend to hold the heat inside the radiator instead of letting it out into the room.

It is important to make clear that heat "reflection" is distinctly different from heat "radiation" from a radiator. In the first instance, the white color of the paint repels the heat which in direct sunlight attacks the building from the outside, while in the case of the radiator, paint may either let the heat through from the inside and radiate it, or hold it back. For cooling purposes, aluminum paint is very similar in its heat reflective properties to white paint, but in the case of a radiator a paint of metallic composition holds the heat in. For a hot water tank or hot water pipes, the use of the metallic paint would help to keep the heat from escaping—opposite from the proper function of paint on a radiator. For a time, it was believed that the color of the paint on a radiator was the deciding factor in the radiation of heat but it has since been found that in this case, the color is not so important, but a flat paint will help to radiate heat somewhat better than a glossy paint. In fact, a flat black paint is almost as useful on a radiator as a flat white paint.

Asbestos fibers are now being used in some aluminum roof coatings which are designed for heat reflection. The mid-year report of the Construction Division of the U. S. Department of Commerce (July, 1947) says:

"An asbestos-fibered aluminum roof coating reflects up to 80 per cent of destructive sun rays, lowers temperatures under the roof 10 to 15 deg and makes roofs last longer. Designed to combat the effect of scorching sun rays which cause roofs to reach 'fever heat' it is also claimed to prevent peeling, blistering and alligatoring, contributing factors that cause roofs to fail prematurely."

In the foregoing connection, it is the aluminum which is the heat reflecting component. The asbestos fiber mechanically reinforces the film and prevents "alligatoring."

Psychological Effects of Color

Psychologically, the intelligent use of paint can be very useful in influencing the *apparent* temperature. For example, clerical employes in an office with a northern exposure, the walls of which were a "cold" blue chronically complained of being chilly, but the complaints stopped when the room was repainted in a warm yellow which simulated sunlight, although the reading of the thermometer remained unchanged. On the other hand, employees in a "hot" room painted red were satisfied when it was painted a "cool" blue—the same color that had "chilled" the employees in the other office.

The foregoing examples are indicative of the new recognition of the use of paint for heat control.

Modern Washrooms

(Continued from page 41)

jector so designed that lips cannot touch it. In drinking, the lips must touch only the stream of water and waste water must be carried away without contaminating the incoming pure water. The projector also must be of the non-squirting type, otherwise water will be wasted and the janitor's time spent in frequently mopping up the floor around the fountain.

An important part of the up-keep of the plumbing is a periodic inspection of all the fittings on the plumbing fixtures. As faucets, especially, receive hard wear and abuse in factories, they should be checked for signs of dripping. If water is dripping regularly from one or more faucets a great deal of water will be needlessly wasted.

Loss Due to Leaks

If a faucet drips 60 drops per minute that adds up to 2,299 gallons of water a year. And if it's a hot water faucet, fuel is being wasted to heat water that is going down the drain!

A faucet leak is due to a worn washer or a worn seat. Washers should be replaced in all faucets that show signs of leaking. The better type faucets today come with a renewable seat which can be replaced when it becomes worn or eroded.

Oftentime trouble will be experienced with pipes "sweating". This can be eliminated by the use of a felt pipe covering.

To retard the formation of scale, and control corrosion and "red water" trouble in piping, a chemical feed such as sodium hexametaphosphate or sodium septophosphate may be injected into the pipes. A standard feeding device for this job has recently been put on the market. A commercial preparation made from food grade phosphate which is harmless, and tasteless in the water is available for use with the feeder.

Because of the larger numbers served by plumbing fixtures in manufacturing establishments the necessity for proper installation is of the greatest importance. After proper installation comes systematic and consistent up-keep. Any plant or factory with good fixtures properly installed and cared for, may be sure of maximum service from their plumbing with minimum maintenance.

Selection, Installation and Maintenance of

Public Address Systems

in Industrial Plants

By C. W. MURFF

Communication Engineer, Construction Department, Westinghouse Electric Corporation

Effect of distance upon loud speaker effectiveness . . . Proper placement of loud speakers . . . Standard of sound measurement, the decibel . . . Loudness of common noises . . . Relation of sound pressure to distance from loud speaker . . . Relation of input to sound pressure . . . Effect of reflected sound . . . Sound projection data . . . Factors in the selection of amplifiers . . . Determining impedance of loud speaker windings . . . Wiring of PA systems

EVERYONE at one time or another and especially during political campaigns has heard announcements from loud speakers mounted atop a sound truck. You will recall that when you first detected such an announcement it came from a distance and was not completely understandable, due to trolley car, vehicle noises, etc., but as it came nearer, you could easily follow every word. You will also remember when one of these trucks was close at hand, the speaker volume was so loud that an extremely annoying vibration was actually set up in some part of your body and existed until the speakers were well removed from your vicinity. Maybe your reaction was similar to the writer's in that you made a mental note to not vote for that particular candidate.

Imagine those same blaring sound truck speakers mounted in one cluster in the center of one of the main aisles in a manufacturing plant. Those workmen in the immediate vicinity of the speakers would be equally as annoyed, as you would be, and more than likely would perform

Fig. 1. Cone type speakers installed in manufacturing aisle of industrial plant

Fig. 2. A high noise level location where trumpet type speakers are mounted on roof trusses near left wall

little or no work. Those at the far end of the aisle probably would not be able to completely understand the announcements while those reasonably removed could easily follow every word at a comfortable volume level.

The proper placement of speakers in respect to the area in which sound is to be provided is important. The volume level required to produce intelligibility throughout the area is of equal importance. Neither can be done properly by guess work and both are necessary in order to realize a successful installation. A successful installation is always cheaper.

If you are one of a large family, how often does Junior turn the radio volume up and Sis immediately turn it down. This goes on, day in and day out, and soon the volume control is worn out. One prefers music soft and bassy, while another demands a volume so loud and shrill to cause Grandma's picture to slide across the table top. Take this same radio into the plant and the employees, all grown men and women, will react in an identical manner. Even though there are ample speakers to provide a comfortable volume level at any spot in a given area, there will invariably be a few who will constantly complain and request more volume. On the other hand, there will be those who will protest the normal and correct volume as being too loud. Fortunately, these extremists fall into the minority group.

One, three, or five watts of power applied to a given speaker will produce a definite value of sound at 5 ft, 50 ft, or 100 ft removed from the speaker. A given noise level will require a definite value of sound pressure in order that speech or music will successfully override the noise.

The standard measurement of the volume intensity of sound is decibels (db). We cannot say that a particular noise is a certain number of decibels loud because the decibel is merely a ratio by definition. It is generally accepted that "0" decibels is the threshold of hearing, being the weakest sound that is audible to a person with normal hearing. Hence, when a particular noise level is stated to be +90 decibels, it means that the noise is 90 decibels above the threshold of hearing. Any minus (—) reading in decibels will assumingly be inaudible to a person with normal hearing. The approximate average loudness level of the more common noises is shown in Table I.

CURTIS W. MURFF

Communications specialist for the Westinghouse Electric Corp., Curtis W. Murff's responsibilities include maintenance of high service standards and low operating costs for efficient inter- and intra-communication among the company's widespread works and offices.

Born in Oklahoma in 1907, he was educated in Fort Worth, Texas, and began his career there as maintenance engineer for the Southwestern Bell Telephone Co. in 1927. He remained with that company until assuming his present duties with Westinghouse in March, 1943.

Noise levels are correctly measured with "Noise Meters" of which several brands are available.

Manufacturers usually rate a particular speaker as having a volume output of "so many" decibels at one (1) watt of power input and at a distance of four feet in front of the speaker. Assume the loudness of a particular speaker at four feet with one (1) watt input being 100 db. The loudness at 8 ft would be 100 minus 6 or 94 db; at 16 ft 88 db; at 32 ft 82 db, etc. Each time the distance is doubled, the volume level from the speaker drops 6 db. (Refer to Table II.)

One often inquires, "If the power into a given speaker is doubled will the sound be twice as loud?" The answer is "No," and is explained as follows:

Assume you were standing 32 ft in front of the aforementioned speaker operating at one (1) watt input and producing a sound level of 82 db. If the power to the speaker were doubled to two (2) watts input, the sound level would be increased to 85 db, a 3 db increase. With each doubling of power to the speaker, the sound level will only increase 3 db. The increase in sound level necessary to double the loudness varies with the original loudness of the sound, but generally around a 10 db increase in sound level will double the loudness. This 10 db increase in sound level will require the speaker to be operated at approximately 10 w input or a power increase of 10. Reference to Table III shows the Relation of Input Power to Sound Pressure.

Sound from loudspeakers or mechanical devices is composed of two (2) sources:

1. Direct Sound
2. Reflected Sound

Sound from the loud speaker will be radiated in all directions, some of which will reach the ear directly, coming straight from the loud speaker. This is referred to as DIRECT SOUND. A portion of the sound will be reflected from walls, floors, ceilings, etc., and eventually will reach the ear. This is known as REFLECTED SOUND. Where reflected sound reaches the ear in less than approximately 1/20 of a second later than the direct sound, it tends to re-enforce the direct sound and is termed BENEFICIAL REFLECTION. Where reflected sound reaches the ear later than approximately 1/20 of a second, it will appear as a second sound rather

TABLE I

Average Home	+ 40 db
Average Office	+ 55 db
Average Conversation	+ 65 db
Average Truck—30 ft away	+ 80 db
Heavy Street Traffic—Trolley Cars, etc.	+ 90 db
Factory Screw Machine—30 ft away	+105 db
Airplane Motor, 15 ft from propeller, 1600 rpm	+125 db
Pneumatic Rock Drill	+130 db

TABLE II—RELATION OF SOUND PRESSURE TO DISTANCE FROM LOUDSPEAKER

Distance from Loudspeaker (Ft)	Sound Pressure % of Reference Point (4 Ft)	Sound Level Reduction from Reference Point (Decibels)
4 (Ref. Point)	100	0
8	50	6.0
12	33.3	9.5
16	25.0	12.0
20	20.0	14.0
25	16.0	16.0
30	13.3	17.5
35	11.4	18.8
40	10.0	20.0
45	9.0	21.0
*50	8.0	21.9
60	6.7	23.5
70	5.7	24.9
80	5.0	26.0
90	4.4	27.0
100	4.0	28.0
125	3.2	30.0
150	2.7	31.5
200	2.0	34.0

*Maximum recommended sound projection distance in local coverage installations.

TABLE III—RELATION OF INPUT POWER TO SOUND PRESSURE

Input Power to Speaker (No. Times Original Power)	Sound Pressure Increase (Decibels)
Original Power (Ref. Pt.)	0
1½	1.75
2	3.00
3	4.75
4	6.00
6	7.75
8	9.00
10	10.00
15	11.75
20	13.00
25	14.00
30	14.75
40	16.00
50	17.00
60	17.75
80	19.00
100	20.00

than as a re-enforcement of the direct sound and is termed ECHO REFLECTION. Therefore, Beneficial Reflection is a result of sound being reflected from but one or two surfaces while Echo Reflection is a result of sound being reflected a number of times and from various surfaces. Reflected sound can easily reach such a proportion that when it finally reaches the ear it is not recognizable as the original (or direct) sound, and when present to any great degree, is defined as REVERBERANT SOUND and will tend to reduce the overall intelligibility.

Each time sound is reflected, there is some loss, or absorption, the amount of which is dependent upon the character of the reflected surfaces. A tile or hard surfaced room offers very little loss and can be termed "live" while a soft surfaced room (heavily draped — acoustical materials, etc.) offers considerable loss and can be termed "dead." It is evident that the amount of reflected sound that reaches the ear varies considerably, depending upon whether the room is live or dead. Therefore, the total sound which reaches the ear can be expressed as:

TOTAL SOUND = DIRECT SOUND + BENEFICIAL REFLECTION + REVERBERANT SOUND

Fig. 3. Control cabinet and recording and phonograph unit installed in a Westinghouse plant

Where a sound is out of doors, reflections are materially reduced and sometimes are non-existent because the sound that would normally be reflected from walls and ceilings indoors goes off into free space outdoors. Therefore, practically all sound reaching the ear out of doors is DIRECT SOUND. Large rooms, such as found in factories often approximate outdoor conditions because walls and ceilings are far enough removed to cause the reflected sound to be sufficiently weakened by the time it reaches the ear.

How much power input is required for a given speaker to override a background noise level at a given distance removed from the speaker? This will depend upon the following:

1. The volume of the background noise.
2. Whether the background noise is of a continuous or intermittent nature.
3. Whether the background noise is a low rumble, or whether its character consists of high pitched components.
4. Frequency response or tone characteristic of the speaker to be used.
5. The type of sound to be furnished i.e., whether it is to be music, speech, or a combination of both.
6. Whether it be for indoor or outdoor use. If for the former, consideration should be given to size, shape and construction of the room.

To properly provide loud speakers in a given area, the engineer will need the sound projection data sheets available from any reputable speaker manufacturer. From this data, he can determine under practically any noise condition which particular type of speakers will be required and the power input at which they should operate. The sound projection data can be relied upon under normal conditions; however, occasionally there will be found conditions which will be in wide variance from the average, and the projection data will lose some degree of accuracy. The most common of these conditions are:

1. Oddly shaped areas (extremely long and narrow).
2. Areas in which there are very large obstructions.
3. Highly reverberant areas.
4. Areas in which there is a high average intensity noise level and especially where the noise is intermittent.
5. Areas in which the background noise has considerable energy content in the frequency range of the sound (speech or music) to be provided.

From the information given to this point, we find that there are too many considerations required to permit the average layman to design and install a sound system in an industrial plant. The average person will walk into an

Fig. 4. Installation of control cabinet phonograph units. Note, installation of radio receiver at the top of the panel. This can be connected to the public address systems in case of important programs

Fig. 5. The PBX switchboard in one of the Westinghouse plants. Microphone in center of front panelboard is used by operator for paging key personnel throughout the entire plant

area and immediately say, "Two speakers are required, one at each end of the aisle." Suppose this area was 200 ft long and the background noise level was 95 db. There are numerous areas with a 95 db noise level. Under this condition, the sound level from the speakers should equal at least 95 db, say 96 db at the center of the aisle or at 100 ft distance from each speaker. Referring to information heretofore given, the sound level at 50 ft would be 96 db + 6 db or 102 db, at 25 ft 108 db, at 12.5 ft 114 db. Therefore, those persons working in the immediate vicinity (12.5 ft) of each speaker would have to tolerate a sound level of 114 db, 19 db above that required to override the background noise. We pointed out that to double loudness an approximate sound level increase of 10 db was required. Here we have a 19 db increase, and the volume level would be approximately four times that actually required. This is the answer to why so many speakers are required in an industrial sound system. Never should a speaker be required to project sound for a distance greater than 35 to 50 ft. In fact, data sheets supplied by the manufacturer usually limit projection to 35 ft and 50 ft.

So far, we have in most part covered only the proper selection and placement of loud speakers. A complete installation in an industrial plant can be divided into four parts and each requires equal consideration:

1. Signal Voltage Generating Equipment—(Microphone, Phonograph, Radio, Time Signal Device, etc.).
2. Amplifying Equipment (Preamplifiers, Booster Amplifiers).
3. Loud Speakers.
4. Wiring system for interconnecting the apparatus in 1, 2 and 3.

Space will not permit a complete discussion on each of the above parts; however, a brief outline of part 2 is included.

In selecting an amplifier to provide power to a given number of speakers, it is first necessary to calculate the total power required. This is done by summarizing the power consumed by each speaker to be connected to the amplifier. It is good practice to use but approximately half the power output capability of the amplifier because:

1. A reasonable amount of power will be left for future expansions or other additional wattage requirements such as an increase caused by a step up in noise level in a particular area, thereby necessitating a greater sound level (more wattage) for overriding the noise.
2. Where an amplifier is operating at less than its full power output, the per cent hum level and other distortion is less than when operating at full output.

It is an easy matter to provide a definite power in watts to a particular speaker and to also provide varied power to several speakers, all of which are to be paralleled on one circuit and connected to the amplifier when the power output of the amplifier and the impedance of its output winding to be used is known.

Assume you are using the 250 ohm output winding of a 25 w amplifier and wish to provide 5 watts of power to a given speaker.

First, we know that 5 w represents only 0.2 or 20 per cent of the available 25 watts. To determine the impedance of the speaker transformer winding in order that it will consume 5 watts of power, the following formula is used.

$$\frac{250}{z} = 0.2$$

$$z = \frac{250}{0.2}$$

$$= 1250 = \text{Impedance of speaker winding to be used.}$$

In this case the maximum number of speakers, each with 1250 ohm line transformers, that could be used with the 25 watt amplifier would be 5 (consuming the full 25 watts power from the amplifier.) These 5 speakers could consume different amounts of power as desired as long as the total power consumption of all 5 speakers does not exceed the power output of the amplifier, but as heretofore stated, it is good practice to use only about half the amplifier output power.

Where amplifiers are to be re-

(Continued on page 57)

Trouble Shooting in Pneumatic Tube Systems

Prolonging life of tube and carriers . . . Locating carrier and obstruction in tube . . . Extracting of carrier . . . Making tube ring repairs . . . Lubrication . . . Kinds of metal in tube . . . Tools used . . .Removing condensate

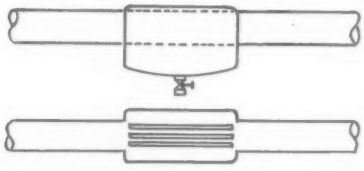
A FEW TOOLS and common sense are all that is needed to maintain a pneumatic tube system.

Carriers are nearly all the same, the only real difference being that some are equipped with a leather disk and a felt head, while others have only the felt head. Maintenance of these parts, which consume more time than any other parts, will vary widely with the installation depending mainly upon the amount of traffic, number of bends and the condensation occurring in the tubes.

Condensation Control

Condensation troubles will not be bothersome on installations that are completely indoors especially if the temperature of the air used remains fairly constant.

Condensation will be much more troublesome where the tubes run outdoors and then indoors again. In systems of this kind the air should be taken from outdoors. Condensation will, of course, usually occur in the lowest point in the line, where a condensate tank should be located. Regular and frequent draining of this tank will keep condensate trouble at a very low point.



The condensate tank is nothing but a tank with the tube running through the top section, the bottoms of the tube being slotted so that the condensate will run out of the tube and into the lower part of the tank where it can do no harm. The force of the air changing directions at turns will cause the moisture in the air to impinge on the wall of the tube. Use of the wiper in front of a carrier before starting the system will usually eliminate this moisture.

The wiper is merely a batch of mixed woolen and cotton strings fastened to a twisted piece of wire, and in the general shape of a carrier. This wiper is placed in the tube and a test carrier put in behind it to furnish the power to push it. It should be wrung out and returned to the central station. Another type of wiper is a carrier with a thin envelope of sheepskin impregnated with "No Oxide" Special A or E. The chemical "No Oxide" puts a fine plastic film on the inside of the tube furnishing a mechanical protection that prevents corrosion.

Condensate will cause the felt head on the carriers to swell lengthwise, causing reduction in the diameter and in time the felt will fail to make an air-tight fit and will have to be replaced. A system that has a large number of turns will wear the felt head unevenly and call for replacement. Replacement is simple; unscrew the two or four screws holding the felt, remove it, and replace with a new felt.

In systems using the leather disk, wear of the felt head is materially reduced, because the leather will take most of the wear resulting from turns and moisture. With felt as hard to obtain as it has been the past few years, the advantage of using the leather disk will be readily appreciated.

Where the tube runs outdoors, as mentioned above, more trouble will ensue from condensation with temperature changes. If, in the winter, freezing should occur, a steam hose of about 50 lb pressure and with the steam as dry as possible will thaw it out. A tube point can be broken near the point where the tube leaves the building and a nozzle not more than half the tube diameter inserted. The balance of the opening should be left open so the condensate can run out if necessary. As the ice thaws the water will run to the nearest condensate tank, so it will be necessary to drain this every few minutes until thawing is completed. Then the wiping process should be followed until the tube is dry enough for use.

Tube Obstructions

Except for freezing, any stopping of the carrier in the tube will mean that there is an obstruction of some sort either in the tube or denting the tube, thereby stopping the carrier. Procedure for extracting the carrier and obstruction then varies with the tube size, length and construction.

If the tube is quite long it is best to use a whistling carrier, but since most lines are only of comparatively short length an ordinary electrician's fish tape will suffice. Bend the end of the tape over so that a hook is formed which will pass the turns easily. Then run the tape into the tube from the nearest point past the obstruction until it contacts the carrier. Work it until the carrier is either hooked or pushed out the other end. Then the obstruction should be removed, if possible.

If the tube is bent the three ball hammer can be used to reform the tube to its proper shape and size. This hammer is a steel cable ¼ in. dia on which are fitted a mandrel and two smaller hammers. The mandrel is free to slide on the cable, while the hammers are fastened solidly to the cable. The mandrel, being the correct size and shape of the tube, is hammered in and out of the bent section in the tube by pulling the cable alternately one way and then the other, until the mandrel will clear easily.

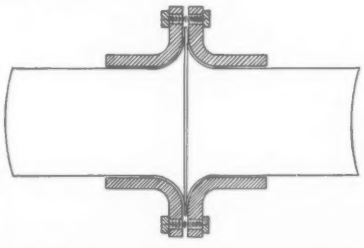
With a long run of tube it is impractical to use a fish tape and a whistling carrier should be used. This carrier is one that has no top and a small hole is drilled in the felt and base so that a small amount of the air will pass through the carrier and blow the whistle when the tube reaches the obstruction. The whistle is merely set in the body of the carrier.

Breaking and Closing a Tube

If it is necessary to break into the tube to remove the obstruction, which will usually be at a turn, it is best to do it at the nearest joint. This would especially be the case with a tube that is joined together with demountable couplings. In the case of a welded tube it could be cut at the nearest straight section. Or in a tube joined with shellac, a few sharp blows on the sleeve will break it loose.

When a joint is to be reformed the procedure will vary with the type of joint used in the system.

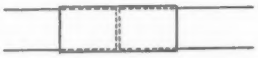
The system utilizing demountable couplings should have the tube ends cleaned of any residue, the ends butted and the coupling then pulled up tight.



Welded systems, as used principally outdoors, will require that a new sleeve be slipped on the tube, the ends of the tubes butted, the sleeve slipped over them and welded. Be

sure all surfaces are clean so no pinhole air leaks are left.

Inside tubes are simple; clean the tube ends and the inside of the sleeve, shellac the tube ends, and slip the



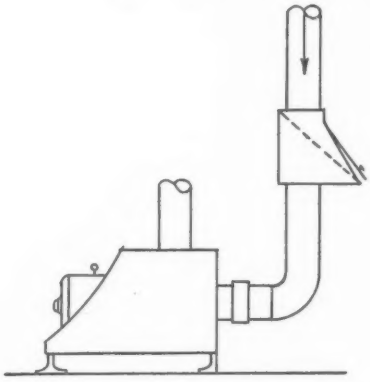
sleeve over them making sure the ends are butted squarely.

After a tube has been closed following repairs it is best to check it for air leaks. Stops in ends with air pressure entering through one stop. 20-25 lb should be sufficient.

Some of the first pneumatic tube systems built had aluminum tubes. The advanatges of aluminum are obvious; light weight, less subject to electrolysis, non-corrosive, easily worked. Copper, steel and brass have long been the standard materials, but aluminum is rapidly becoming the most popular. Its use imposes only one limitation, and it is a minor one; on outside lines it is necessary that the tubes be joined with demountable couplings. Copper also comes under this restriction.

Clean Out Screen

The clean out screen, located just ahead of the exhauster inlet with the vacuum system, or just above the outlet on the pressure system, must be



cleaned frequently. In a department store it should be cleaned at least once a week. In industrials and general offices, where the traffic is not too heavy it can be cleaned once a month. Any drop in the vacuum or pressure will usually result from paper or other objects blocking this screen.

Miscellaneous Maintenance

Oiling of springs and hinges on doors will lengthen their life. Occasionally the springs or covers on the doors will become weak or worn and will have to be replaced.

Oiling of the motor bearings on the blower or exhauster should be done weekly. If these units are in the engine room the oiler can care for them on his daily schedule.

The only time any lubrication should be used in a tube is during the initial breaking in period. This will usually be done by the service engineer of the firm making the installation. When he is satisfied that the tube is correct he will issue instructions that oil or grease should NEVER be used in the tube from that time on.

Public Address Systems

(Continued from page 55)

motely located in respect to the preamplifier (driver amplifier) in order that the speaker wiring may be kept as short as possible, it is not necessary to provide line matching transformers at the inputs of the power amplifiers. This also applies where the pre-amplifier and all amplifiers are contained in one unit. Common practice today permits connecting the output winding of a preamplifier directly into the grids of as many as 200 amplifiers paralleled. As an example one leading manufacturer of this equipment recommends the 15 ohm output winding of a particular 6 watt amplifier (for use as a pre-amplifier) being connected directly into the grids of as many as 200 of their 50 watt booster amplifiers. The only requirements being that (1) the end of the line be terminated with a resistance of from 100 to 200 ohms, (2) that the line should not normally exceed a distance of approximately 1000 ft, and (3) the amplifier should be provided with a coupling condenser between the hot (ungrounded) side of the line and the grid of the first tube. The 1000 ft line length limitation is due to the possibility of noise pick-up rather than to frequency discrimination or loss of power.

Wiring in Public Address Systems can be treated as follows:

1. All Circuits connected to signal generating apparatus such as Microphones, Phonograph pickups, Radios with low level output, etc., should be installed individually and be completely shielded.
2. All Circuits from pre-amplifiers to power amplifiers will in most instances require shielding. Where extreme care is taken to avoid running these circuits parallel to wiring associated with neon lights, brush type electric motors, strong radio frequency fields, and other sources of interference, it is possible that they could be installed open; however, as a matter of precaution, it is best that they be shielded.
3. All Cirucits from power amplifiers to loud speakers will not need shielding unless there is considerable induction to Radio frequency transmitters, such as diathermy and other RF heat treating devices.

"As both the current and voltage impressed upon the wiring in 1 and 2 is low, the wire size is relatively unimportant, but should not be smaller than No. 22 gage. The current impressed upon loud speaker circuits, especially where several speakers are connected to one relatively long circuit, can be sufficiently high to warrant larger size wire. These circuits should be treated in a manner similar to lighting circuits in that the wire size will be in accordance with the Electrical Codes."

During the war a number of Plants installed Public Address Systems. Some of these systems are still in use while others are idle. Most of them were used mainly for playing selected music to production employees and for special announcements, while a few were in addition partially used for paging purposes. Competent sound engineers and manufacturers contend that these systems should be used more extensively for paging purposes.

Until reecntly it was not an easy matter to obtain these systems on a unit basis, i.e. all amplifier and preamplifier and control equipment contained in one small and neat appearing console cabinet. These console units are especially useful where all equipment can be centralized, and speaker and signal generating apparatus are not too far removed.

The installation of any Industrial Sound System, regardless of size; requires the services of a specialist in this type of work. This specialist should, by all means, be entirely responsible for the engineering, selection of euipment, supervising the installation, and the final testing. Where work is to be performed by the average electrical contractor, he (the contractor) should be required to discuss with the engineer, the job in its entirety, before work is started and remain in close contact with him until the job is finished.

Maintenance of these systems should not be difficult, but here again the services of a specialist is required. In most every plant there are employees who hold amateur Radio Licenses and the average amateur holding a Class "A" license should be capable of performing any form of maintenance work on a sound system.

SAID TO BE adaptable to space heating of temporary buildings or those under construction is a gasoline-burning general-utility unit weighing 312 pounds that can be transported from place to place by one man. It will thaw frozen areas and machinery, and dry and cure such materials as plaster, paint, and concrete.

Sprinkler Systems Need Regular Inspection

Infrequency of operation is conducive to maintenance neglect . . . Give best service under one man's responsibility . . . Principles of operation . . . Systems in common use . . . Underwriters' approved types of sprinklers . . . Pointers on inspection and maintenance

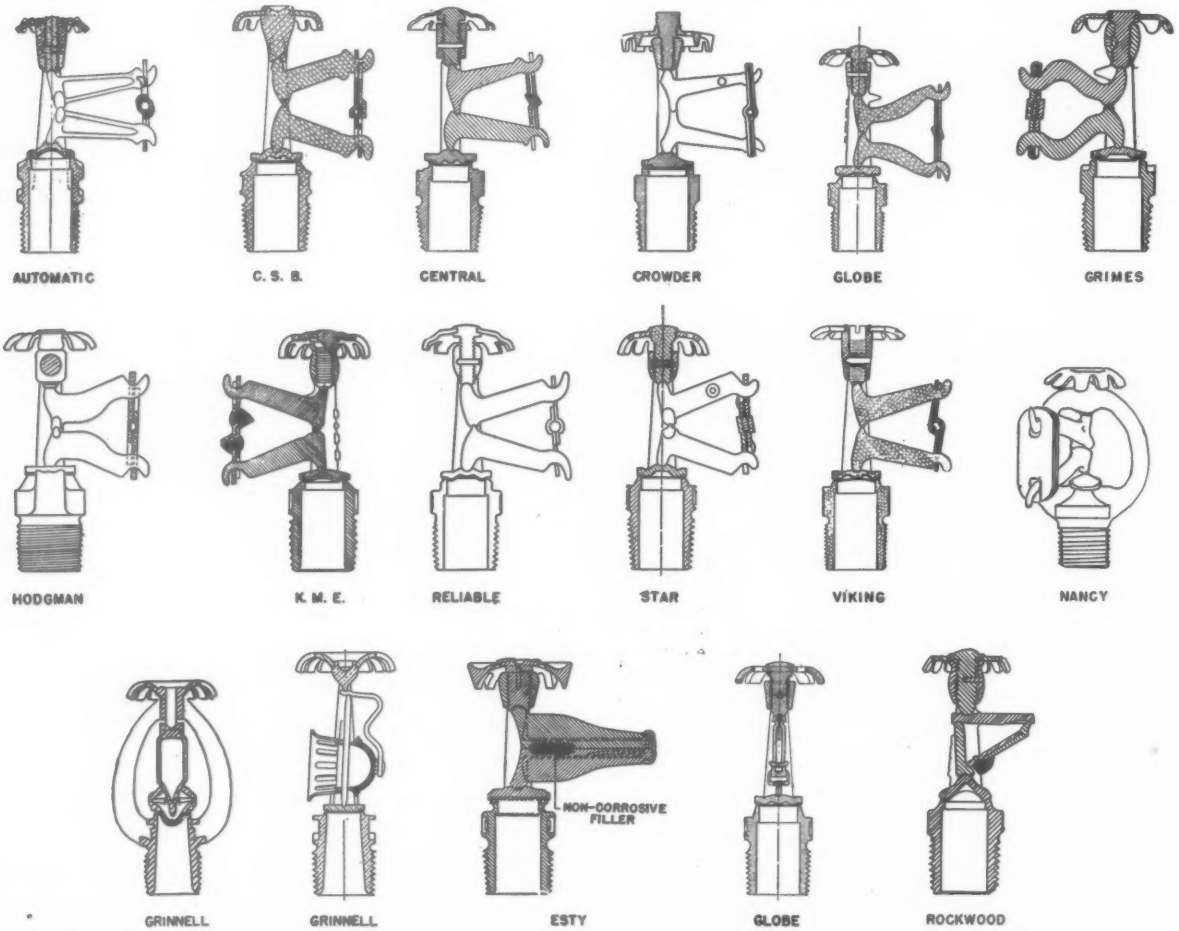
ALL AUTOMATIC devices work satisfactorily only when specification conditions are accurately maintained. This statement very appropriately applies to automatic fire protection sprinkler systems that are not wanted to operate except in the emergency of an unwanted fire.

In the care of sprinkler systems, the infrequency of operation is conducive to neglect on the part of the maintenance man. To keep these systems in proper condition, therefore, it is advisable to set up and carefully execute a program of periodic inspection, reporting and maintenance. Responsibility for the maintenance of the system should rest squarely on one man.

Automatic water sprinkling systems are so designed as to cause sprays of water to be played on fires started in spaces protected by the system. In the conventional system, a series of parallel pipes is supported near the ceiling of the space to be protected. Attached to these pipes at proper intervals are the sprinkler heads so designed as to open under pressure of water or air in the pipes when the temperature reaches an abnormally high point. For ordinary service the rated temperatures range from 135 to 165 F at the ceiling, for special conditions, however, the rating may be as high as 600 F.

This series of pipes is attached to a manifold kept continuously under pressure by automatically controlled fire pumps. The opening of one or more sprinkler heads causes an immediate drop in pressure within the piping system which impulse sets off alarms and starts fire pumps in operation to deliver water to the open sprinkler heads under which fire has started. Although some automatic systems employ carbon dioxide as the extinguishing medium, water is most commonly used and statements here will refer to water sytems only.

Two types of water systems are in common use, i.e., wet and dry. In



Cross sections of sprinkler heads approved by the Underwriters Laboratories. Top two rows are of the link and lever types. Bottom row, the types from left to right are: Frangible globe (non-solder), spring and lever strut, duck bill, chemical (non-solder), and triangular strut

the wet system, the entire piping system is maintained filled with water under pressure clear up to the sprinkler heads. Systems of this type have been found entirely satisfactory where the temperature does not get down to the freezing point at any point in the system.

Where piping must be placed in locations that are likely to reach temperatures below 32 F, what is known as the dry system is required by insurance regulations. In this system, the pipes are filled with air under pressure but, when the sprinkler heads open, the air escapes and water is pumped into the system to spray the fire, as with the wet system.

Types of Sprinklers

Underwriters' Laboratories have approved 17 different designs of sprinkler heads which may be classified under six distinct types, namely: link and lever; frangible bulb (non-solder); spring lever and strut; duck bill; chemical (non-solder); and triangular-strut.

To meet requirements, these sprinklers are designed to withstand 300 psi pressure and have ½ in. discharge orifices of ring nozzle type or 7/16 in. tapered nozzle orifices. The discharge from a ½ in. nozzle varies with flowing pressure as follows:

Flowing Pressure psi	Discharge gpm
5	12.80
10	18.10
20	25.80
30	32.80
40	37.20
50	42.20

In principle, solder type sprinkler heads are automatic valves with a plug for a disc that is held in closed position by a linkage system, or strut, in which a soldered joint, by melting at a specified temperature, acts as a relay or fuse to permit the pressure within the sytem to open the orifice. Bulb type sprinklers employ a glass bulb, nearly filled with a liquid that expands with heat and shatters the bulb at a specified temperature. This action takes the holding force off the stopper, permitting the pressure within the system to open the sprinkler and spray water in the vicinity of the sprinkler.

The approved chemical type of sprinkler has a strut in which is placed a small cylinder containing a low-fusing chemical which varies with the operating temperature of the head. Resting on this chemical is a small piston shaped metal piece which holds in place the parts of the strut. At the rated temperature, the chemical liquifies and is forced out around the cylinder at the piston. This allows the strut to collapse and the valve to be forced open by the water pressure.

Some of the fundamental principles to be kept in mind by the maintenance man are:

The spray of water from the sprinkler should not be obstructed.

Stock to be protected should not be piled around the sprinklers so as to obstruct the distribution of water, spray from the sprinklers should completely cover the area for which it is designed.

Cleanliness of the sprinklers is of first importance, for any obstruction of heat transfer from the fire to the sprinkler will partially or completely destroy its function. No paint, calcimine or other coating should be put on these elements, and dust removal should be a regular routine job.

Vertical drafts should be prevented by protecting floor openings.

Protection should be given concealed spaces in floors and walls.

Water service must be adequate in pressure and volume to supply the needs of the sprinklers that will operate, and water should not be turned off until the fire is completely extinguished.

All valves in the water supply system should be kept open and pressure up to normal at all times except while actual maintenance is in progress.

Sprinkler protection should be complete in all areas to be protected.

Protection of equipment against freezing must be provided.

Sprinkler piping should not be used for any other purpose than fire protection. Nothing should be hung upon them.

Routine inspection of all equipment in the system should be made at least once a week. This should include specifically: control valves; gages; water flow tests; inspection of automatic sprinklers for general conditions, cleanliness, corrosion or loading, paint or whitewash, damage, leaks, scale accumulation; removal and testing of sprinklers chosen at random or according to a routine plan; piping condition; hangers; check on air pressure in dry-pipe systems; priming water level; cold weather appliances; water flow alarm devices; central station supervisory system; gravity tanks; pressure tanks; fire pumps; and fire department connections.

Sprinkler systems may be depended to give warning of and extinguish incipient fires only when properly maintained in accordance with instructions given by Underwriters' Laboratories and manufacturers of the specific equipment installed.

"It's been running pretty hot lately"

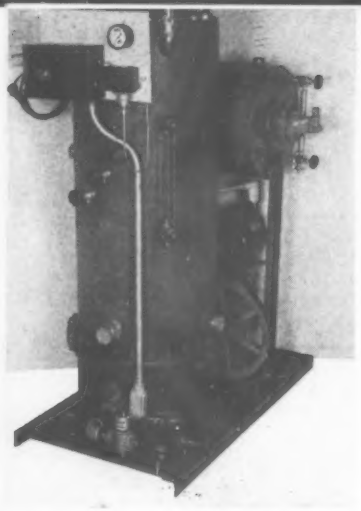


Fig. 1. Alert vertical fire-tube unit, 2 to 15 hp (60 to 450 lb per hr), 125 psi, gas-fired (or oil) automatic water control

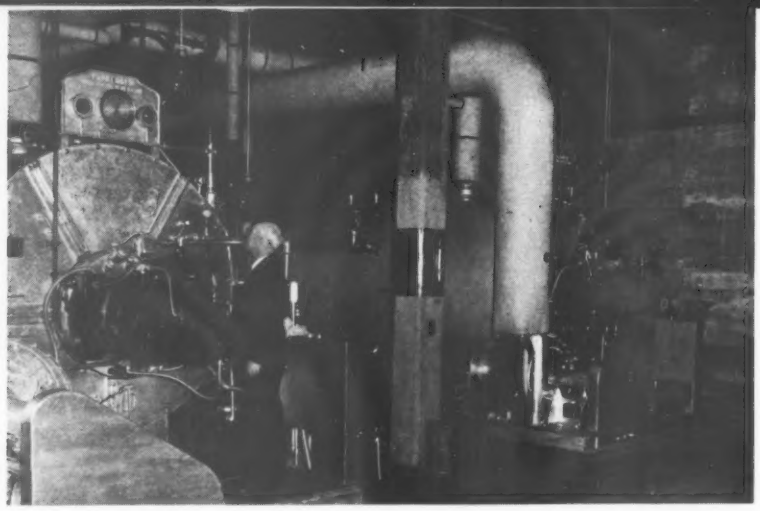


Fig. 2. View of 200-hp and 125-hp Preferred unit steam generator installation, 15 psi g. Standard capacities, 10-30 hp, 2-pass; 40 to 500 hp, 4-pass for heavy oil; pressures to 200 psi; induced draft, automatic purging before ignition. Full automatic starting at any output. Burns all grades of oil including No. 6.

Industrial Steam in Packages

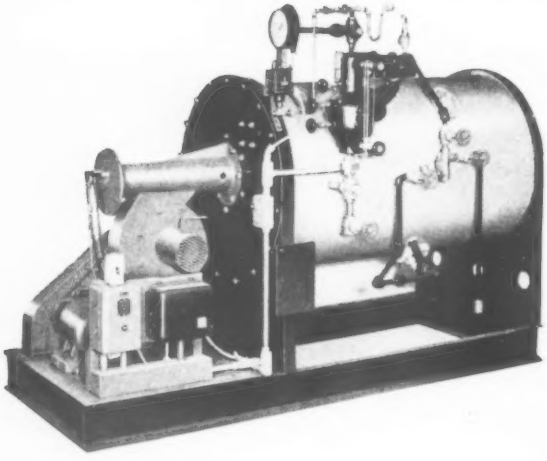


Fig. 3—Left. Heavy-duty Cleaver-Brooks 15-hp, 4-pass down-draft unit, 15 to 200 psi; blower-burner for light oil; flame failure and low-water controls shut down unit. Larger units made for 80 to 500 hp (250 to 15,000 lb steam per hr) for heavy oil, semi-automatic operation. For light oil, fully automatic operation, sizes 15 to 125 hp.

SELF-CONTAINED steam generating units have usually been referred to as "package" units. Such a unit consists of: boiler and furnace; firing equipment and mechanical draft equipment; feedwater pump; all necessary combustion, feedwater and safety controls. These are all designed and assembled as one unit (with insulation), shipped to the user in one unit and, for installation, need only a simple foundation, and connections to fuel, water, electricity for auxiliaries and to a flue-gas discharge duct.

This term "package" has been applied most frequently to the fire-tube type of self-contained unit. Completely-assembled water-tube boiler alone, shipped in one unit from the factory but requiring addition of auxiliaries has also been called "package" unit — many believe incorrectly. Manufacturers should resolve this definition.

Fig. 4. Steam-Pak unit, capacities 15 to 100 hp (525 to 3500 lb steam per hr) at 125 psi; EDR 2100 to 13,500 on low pressure heating units. On 50 to 100-hp models, modulating control to adjust firing to load and maintain steam pressure. On 15-30 hp units, on-and-off control. Oil-fired, 3-pass, down-draft, iris shutter control of combustion air; pressure blower

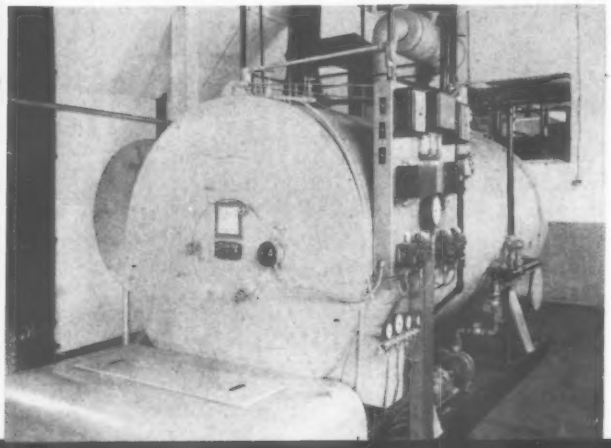
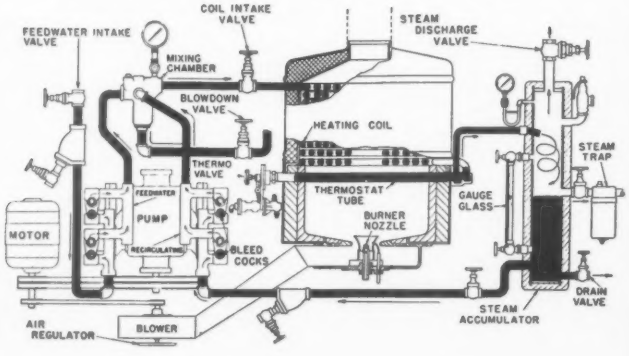


Fig. 5. Clayton forced-circulation type water tube unit, 10 to 100 hp (300 to 3000 lb per hr) 150 psi maximum. Oil fired, pressure atomizing burner, or gas fired. Forced draft, designed for 5-min. start-up; 75-80 per cent efficiency. Complete automatic control. Continuous or intermittent service. Continuous recirculation of excess water, steam separated in separating chamber



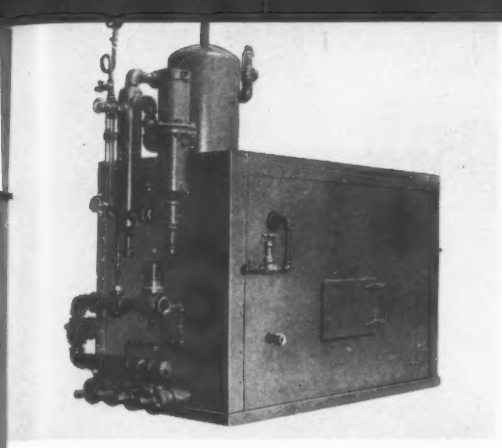


Fig. 6. Steamaster automatic water-tube unit Model A, 3½, 5 and 7½ hp, upshot gas burner; also designed for oil burner. Bent tubes and headers. Larger models inclined water tubes, sectional steel headers and steam drum, to 150 hp; 100 psi WSP, automatic controls. Natural circulation

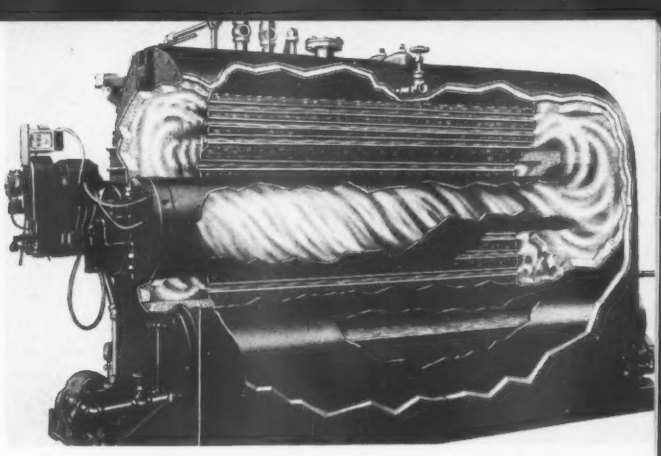


Fig. 7. Econotherm automatic unit, 20-160 hp (700-5520 lb per hr) 3-pass; induced draft; rotary combustion; oil or gas firing; boiler feed and condensate return system; ignition, flame failure, low-water safety and full automatic combustion controls

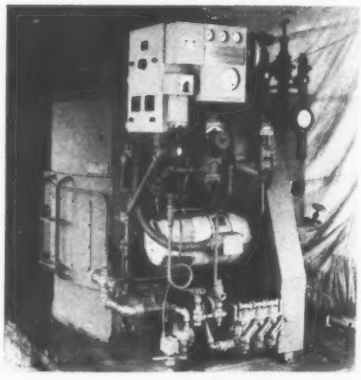
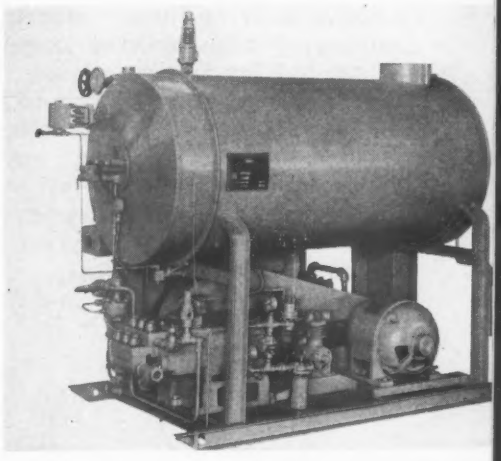


Fig. 8—Above. Vapor-Clarkson forced circulation water-tube, 300-3000 lb steam per hr, (plus 20 per cent for max. cap.). Full automatic or on-and-off control. Oil burning, single motor operates feed pump, fuel pump, combustion air fan. Excess water circulated, steam separated in separating chamber

Fig. 10—Right. Besler water-tube forced-circulation unit for industrial service. Capacity 1750 lb per hr max. 350 lb per hr min. Pressure between 75 and 400 psi max. Oil or gas firing, forced draft, push-button starting, full modulating automatic control, triplex feed pump. Removable cartridge type spiral coil heating surface, helical coil combustion chamber. Evaporation 18 lb per hr per sq ft h.s. at 80 per cent efficiency. Spillover cycle; excess water recirculated



The fire-tube types are usually modifications of the Scotch marine boiler, arranged for 1, 2, 3, or 4 gas passes, using either forced or induced draft, usually burning heavy or light oil or gas. Mechanical draft obviates need of large chimneys. High gas velocities, high combustion rates and high heat transfer are usually employed.

Water-tube types are often of the forced-circulation coil type, the coils forming the combustion chamber and also forming either steam generating or superheating surfaces. In this type there are no drums or steam storage spaces, the steam being generated as demanded, water entering one end of the coil and issuing at the other as steam. In several types, excess water is recirculated and the steam separated in a separating device.

Capacities of the package types range from about 300 lb per hr of steam up to about 15,000 lb per hr, but are normally 3000 or 4000 lb per hr, although one small unit is designed for approximately 100 lb per hr. Multiple units of same or different sizes may fit load conditions. Steam pressures of 15 to 100 or 150 psi are usually required. Water-tube types permit using pressures up to 300 psi and one type generates at pressures up to 1500 psi for test work.

Automatic controls for combustion, feedwater flow, and safety devices, (especially flame failure and ignition controls) are extremely important on self-contained units. Controls must be properly built, correctly applied, frequently checked, properly maintained.

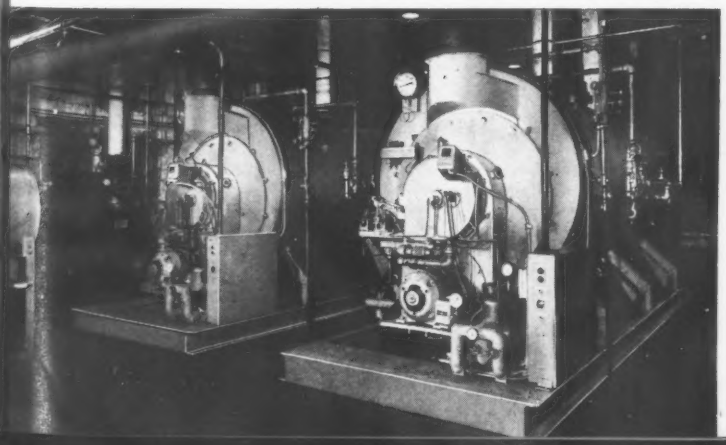


Fig. 9—Left. Installation of two 200-hp Cyclotherm units. All units are fire-tube, 2-pass, horizontal units; forced draft; oil firing (light and heavy, incl No. 6), gas or combination; capacities 5 to 300 hp (175 to 10,000 lb steam per hr), 200 psi maximum. Rotary combustion; full automatic control; ignition, flame failure, water controls. Modulating controls to maintain steam pressure on 80 to 300 hp models; others on-and-off control

Fig. 11. Stout Submersion unit; Scotch boiler; gas jets firing down tubes

Modern Mechanical Transmission

Engineering V-Belt Drive to Cut Maintenance Costs

By FRANK H. RUMBLE,
Texrope Department, Allis-Chalmers Mfg. Co.

Adequate drive for any application can be obtained by employing standardized instructions of manufacturers . . . Do not try to save money by cutting corners on first cost, you probably will end up by paying more in the long run . . . Smaller-than-recommended sheaves cause trouble and belt deterioration by setting up stresses in the belt which eventually result in heat-breakdown . . . It is far better to use sheaves larger than recommended as laboratory tests have shown that belts may last twice as long on large sheaves . . . Belt replacement offsets extra cost of sheaves . . . Installation of belts and sheaves

THE MECHANICS of engineering a V-belt drive are well standardized, with the result that an adequate drive for any application is usually obtained by following the instructions contained in the catalog of any reputable manufacturer of V-belts or sheaves. Although the instructions may vary somewhat in method, all are based on the same fundamental principles of belt ratings, speeds, ratios, horsepower of motors, load factors, and nature of driven machines.

The best protection for the purchaser of V-belts and drives with the least maintenance expense, is to make sure that the drive is engineered in accordance with these fundamentals. This will insure the drive being large enough to handle the job, with sheave diameters large enough to give maximum belt life.

It is often a temptation when costs are budgeted closely or competition becomes too keen to skimp on the number of belts or the diameter of sheaves used on the drive. Either one will, of course, lower the first cost, and the drive for a time may appear efficient enough. However, such a drive will have a shorter life and the purchaser will pay in maintenance many times over what an additional belt or slightly larger sheave would have cost originally. To under-belt a drive is extremely poor economy.

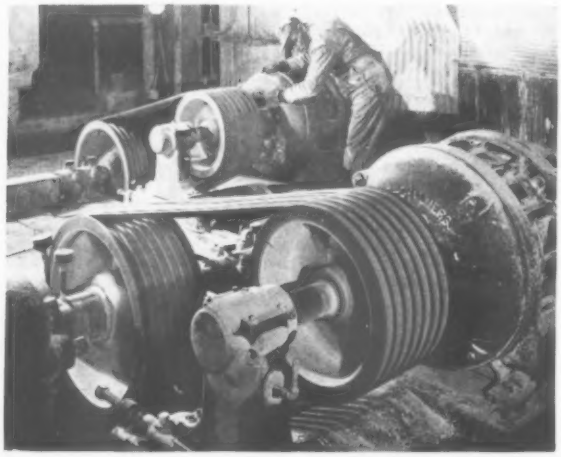


Fig. 1. Short-center V-belt drives are desirable wherever possible. In this photo are shown two V-belt drives on small crushers in a Missouri quarry

Minimum sheave diameters have a definite relationship to the width and thickness of the belts used on the drive. Standard rubber V-belts are constructed of fabric, cord and rubber in what the various manufacturers feel is the proper proportion to stand up longest under the work they have to do. The bending of a V-belt in a natural, easy arc determines the smallest sheave which can be used without distorting the belt. If the belt is bent beyond this "easy arc," its super structure is distorted and internal friction is set up which heats up the whole belt. This soon causes so-called "ply separation" and belt deterioration. The use of larger diameter sheaves reduces the internal friction and heat in the belt. It has been found that for the five popular belt sizes, minimum sheave diameters can be recommended. These sizes were determined after many tests and found satisfactory in practice. They are as follows:

A Section Belts, 3.0 in. diameter sheave minimum.

B Section Belts, 5.4 in. diameter sheave minimum.

C Section Belts, 9.0 in. diameter sheave minimum.

D Section Belts, 13.0 in. diameter sheave minimum.

E Section Belts, 21.6 in. diameter sheave minimum.

Hold to Recommendations

The question is often asked, "Can sheaves smaller than these recommended minimum diameters be used?" Practical experience and laboratory tests show that it is permissible to use sheaves as small as the recommended minimum. It is better to use sheaves somewhat larger than the minimum, however. Using a 13.0 in. diameter or 12.4 in. diameter sheave with a D section belt, for instance ,is not the difference between success or failure of the drive. However, it may safely be said that using a 14.0 in. instead of a 12.4 in. dia sheave will make an almost unbelievable difference in belt life. For instance, if properly cared-for belts on a drive using a 12.4 in. sheave have a life of two years, it is not unusual to find the same drive using a 14.0 in. sheave show a belt life of four years or more.

Therefore, when installing a V-belt drive, it is good practice to consider the belt replacement angle. True, the

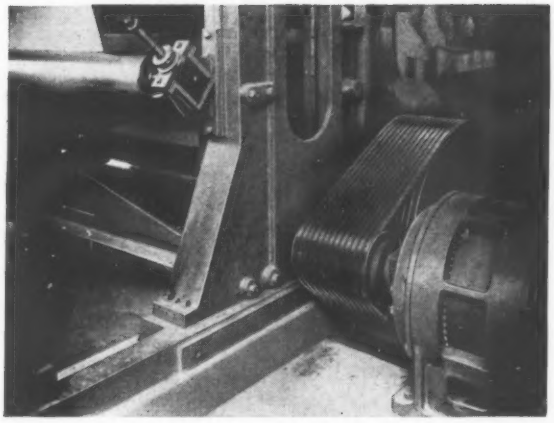


Fig. 2. This picture shows another short-center drive operating a rewinder in an Alabama paper paper mill. Not only does the short-center drive provide compactness and save space but the shorter belts are less expensive and require fewer adjustments

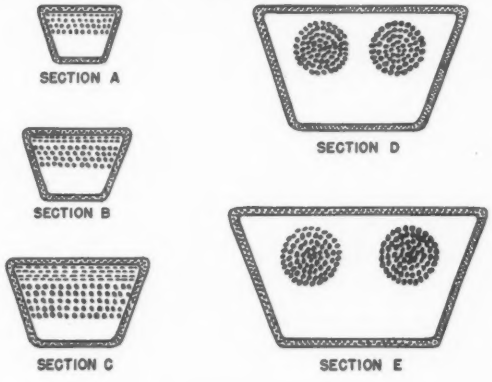


Fig. 3. Actual belt sizes are shown here for Section A, B, C, D, and E belts

larger diameter sheaves cost more originally, but belt life is longer and the belts need not be replaced nearly so often. The cost of even one set of replacement belts usually offsets the difference in cost of the larger sheaves.

Another point to consider is belt speed and its relation to horsepower. Good V-belt practice generally prescribes a belt velocity of between 1,000 and 5,000 fpm. Within these limits, the larger the diameter of the sheaves the greater the belt speed and the more horsepower each belt will transmit. For example, a D section belt when used on a 14.0 in. sheave driven by a 1,150 rpm motor will have a horsepower rating of 17.9 as compared to 15.3 when a 13.0 in. sheave is used. Use of larger diameter sheaves often results in fewer belts being required on a drive, again showing a saving on belts both on the original set and on replacements.

Compactness and space saving are often pointed out as among the chief advantages derived from the ability of the V-belt drive to operate on extremely short centers. These are outstanding features, but a further and quite important advantage of using the shortest practicable center on every drive is that it lowers the maintenance cost. This is accomplished in two ways: First, shorter belts are lower in first cost and for replacements when they become necessary. Second, short belts require less adjustment; it is easier to maintain the proper tension on a short center drive. Long belts frequently set up a whipping action, especially under variable load conditions. This causes considerable stretching action and loose belts are likely to be the result.

Of course, for maximum efficiency a V-belt drive must be properly installed. Matched belts should be used. Sheaves should be truly alined so that belts will not wear unevenly. Guards, if used, should be well ventilated for even the most scientifically constructed belts will have their life shortened if there is no circulation of air to carry away the intense heat developed by friction. Belt tension is all important. To permit proper tension to be maintained and to provide for easy and proper belt replacement, every drive should include some form of belt take-up, preferably slide rails, an adjustable motor base, or an idler arrangement.

The V-belt drive that is properly designed, installed and maintained with due regard to the points mentioned, will give long trouble free service with a minimum of maintenance expense. However, the most carefully engineered drives require a certain amount of simple maintenance to keep them at highest efficiency and a systematic maintenance program that will insure the drive receiving a periodic check-up is much to be desired.

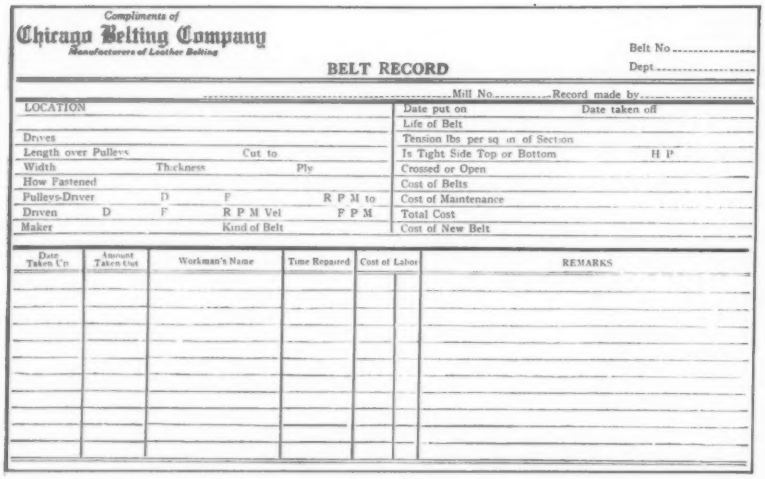
Flat Leather Belting Maintenance .. Its Why and How

By K. BRAD STILES, *Chicago Belting Co.*

Relation of belting cost to power bill . . . It's up to the plant engineer or the maintenance department to sell idea that belting is actually horsepower delivered . . . On correct drive depends efficient operation of expensive and highly complex machinery . . . Figuring horsepower ratings of belting . . . Factors which affect power transmission ability of belting . . . Necessity for spare belts . . . How to calculate correct direction of drive

WEBSTER DEFINES maintenance as the upkeep of property, machinery and equipment. The way I see it flat leather belting maintenance is just another way of saying maximum delivered horse power to the driven machine with a minimum of loss and (barring accidents) continuous operation throughout the work cycle.

Sounds good, doesn't it? But let's go up to the front office or to the purchasing department. Have they ever been sold on the idea that leather belting is horse power delivered, and is directly related to their power bill? The answer is usually "No." Leather belting to that department in this particular plant is a commodity just like paper, nails, bolts, nuts, etc.—just one of a number of maintenance items—so that a new $5,000 machine may end up with a belt which is a misapplication because, in the first place, it was requisitioned as merely "—— feet of double ply 4 in." by the maintenance department, and the purchasing department sent out competitive bids and bought a 4 in. double leather belt without the bidders knowing or trying to find out



Compliments of
Chicago Belting Company
Manufacturers of Leather Belting

BELT RECORD

Belt No.....
Dept.....
Mill No.....Record made by.....

LOCATION		Date put on	Date taken off
		Life of Belt	
Drives		Tension lbs. per sq. in. of Section	
Length over Pulleys	Cut to	Is Tight Side Top or Bottom	H P
Width	Thickness Ply	Crossed or Open	
How Fastened		Cost of Belts	
Pulleys-Driver D	F R P M to	Cost of Maintenance	
Driven D	F R P M Vel F P M	Total Cost	
Maker	Kind of Belt	Cost of New Belt	

Date Taken Up	Amount Taken Out	Workman's Name	Time Repaired	Cost of Labor		REMARKS

Fig. 1. This is a sample belt record card which is supplied by one company to its customers

where the belt was to be used or the specifications of the drive.

You can not blame the purchasing department—this practice dates back to the days when there was only leather belting obtainable as a transmission medium to the driven machine and you could buy single or double, and that was it. Those were the days when common labor got a dollar per day, and mass production wasn't even a dream.

Leather belting is still made of leather, but modern methods of manufacture throughout the industry, plus product development, have kept pace with the production requirements of industry, which means the progressive leather belting manufacturer has probably fifteen different grades and thickness of belting—including oak and chrome retan leather, as well as a number of special belts.

The salesman has become a sales engineer. What about the belt for that $5,000 machine? How are we going to get the maintenance department, the purchasing department, the leather belting manufacturer and the sales engineer together, so that the machine in question is equipped with the correct belt which will operate that $5,000 investment at maximum production capacity throughout each work cycle. The answer is obvious.

Have the sales engineer get together with the maintenance department, make a survey of each production machine in the plant, listing the proper belt for each drive. This can be made a permanent record in the maintenance department by the use of a belt record containing the belt history of each machine. These cards can be kept in a card file with very little effort and the result is a continuous record of the operation of each belt on each machine. Take-ups and belt history become a part of the record, and will pay dividends more than offsetting the time and expense of the compilation and maintenance.

This card record will show up marginal drives, where belt costs are high and production low, and these drives can be redesigned where pulleys are so located that larger diameters or wider faces may be used enabling higher belt speeds and wider belts.

When a new machine is ready for installation, the sales engineer is called in for his recommendation, and the specification is made a part of the record.

In laying out a new drive, always bear in mind that it pays dividends to install a belt with an overload capacity beyond the maximum load requirements of the drive. It's like a five-ton truck with a three-ton load—its life is increased and it requires a minimum of maintenance.

When figuring horse power ratings of leather belting always take into consideration that line start motors require more belt capacity than capacitor start motors. 4500 fpm is an ideal belt speed.

Paper and laminated wood pulleys have a higher coefficient of friction than steel or cast iron pulleys. Dust may reduce belt carrying capacity as much as 40 per cent and oil can reduce the carrying capacity of the belt in some cases as much as 50 per cent.

A good rule for quick estimation of transmitting capacity of double leather belting under ideal conditions is that at a belt speed of 4000 fpm the belt will transmit ten times its width in horse power. For example—a 4 in. double ply belt at 4000 ft belt speed would transmit 40 hp.

The belt's length can be determined by applying the equation: $\text{Length} = 2C + (1.57 \times (D+d)) + \frac{(D-d)^2}{4C}$ where C equals center distance between pulleys. D and d equal the pulley diameters.

Preventive Maintenance is receiving lots of attention throughout industry today, and rightly so, as there are so many major shutdowns which can be avoided by the application of the time-old adage, "An ounce of prevention is worth a pound of cure." Here are some suggestions as to preventive maintenance which is good information for all maintenance men:

There are three factors that cause a belt to transmit power—tension, or the pressure exerted by the belt against the pulley; the coefficient of friction of the belt, commonly known as pulley adhesion, and the speed at which the belt travels expressed in feet per minute.

It stands to reason, therefore, that stretch in the belt causes a reduction in tension which, if allowed to continue, will cause power loss or slippage. Keep belts operating at proper tension. Machine oil, dust or foreign matter on the surface of the belt will cause a decrease in the pulley adhesion, and eventually will result in slippage. Keep belts clean.

Well designed short center drives with pivoted motor bases and paper or laminated motor pulleys approach ideal operating conditions as the tension is present in the belt at all times and the drive is laid out to transmit a given amount of horse power, the proper pulley diameters being selected and the correct width and thickness of belt chosen.

Well designed idler drives are efficient, but cause a reverse bend in the belt which produces excessive flexing, requiring a perfectly cemented belt. Some manufacturers recommend special construction for idler drives. Key drives which operate machines whose failure may affect a whole department causing a work stoppage, such as air compressors and special machines, can be assured of continuous operation by keeping a spare belt on hand at all times.

Machines operating with oil contacting the belt (such as screw machines) can be kept operating with high efficiency by having a spare set of belts on hand and changing belts when necessary. This can be easily accomplished by using a metal fastener, thus permitting the belt to be of the correct length, and pre-laced. It merely means placing the belt around the pulleys and putting the pin through the lacing. Oil can be removed by submerging the belt in a closed can of gasoline or carbon tetrachloride for 24 hr. Allow belt to then dry in air and dress it with a good animal oil dressing before installing to provide lubrication for the leather and resistance to mineral oil.

In order to increase production many machines such as multiple spindle drill presses are being operated with multiple drill heads in each spindle. This throws a load on the belt which is much greater than originally anticipated by the machine tool builder. If you are having trouble in this respect, consult your leather belting manufacturer. He may have a

special belt of his design for these particular machines.

Always run single ply belts with the grain or hair side of the leather to the pulley and the point of the lap against the pulley and away from the wind, on the outside, but use double ply belts wherever possible—it will pay dividends. Do not use single ply belts on step cone pulleys. Double ply will last longer and pull better.

When cutting off belts from roll or preparatory to lacing, be sure to cut them square. Use a straight edge. Placing one man in charge of leather belting maintenance will produce more efficient results than having each machine operator look after his own belts. Belts should be inspected periodically, to see that the laps are in good condition, and that the lacing is not broken or wearing. Renew worn fasteners before they give way, and cause belt damage.

It is dangerous to run on a belt wider than 5 in. in width, as it may spring the belt. A good plan is to install all belts over 4 in. wide with clamps and rods. Excessive crown can cause short belt life, and early belt repairs. Be sure pulleys are in line. If belt runs off it may stretch unevenly across the width, and will also reduce the carrying capacity of the belt. On vertical belt drives, use pivoted motor bases wherever possible.

Operate belts with pulling side on bottom wherever possible. On an open center drive, the slack side on top gives increased pulley contact, and increases belt capacity. Use endless belts wherever possible.

When cementing oily belts always clean leather before cementing with carbon tetrachloride or gasoline. Dress all leather belts periodically with high grade animal oil to prevent dry rot and to maintain their grip and pulling efficiency.

Maintenance Hints

Scheduled Inspection of Material Handling Equipment

By C. C. Hermann

MATERIAL handling equipment such as electric lift trucks require regular inspection and prompt maintenance if a breakdown in material flow is to be avoided. Realizing the importance of the material handling equipment and the necessity for such equipment to be in tip-top shape mechanically and electrically one manufacturer has insisted that regular inspections be set up. A maintenance follow-up card is kept in the maintenance department on every truck, crane and conveyor.

As the date of inspection comes up the card is removed from its pocket and deposited on the work bench of the inspector. The inspector proceeds to make his inspection, card in hand, and notes thereon the exact condition found.

The procedure of inspection has taken the inspector to one of the electric lift trucks as shown in the accompanying illustration where he is going over the controller. He examines the contacts to see if they are roughened to the point where sparking and burning will occur. An inspection of this type is made every third day of operation.

Battery inspection and charging is taken care of nightly. It is claimed that truck idle time has been cut nearly 70 per cent by this simple inspection which takes about fifteen minutes every third day.

Fig. 1. Here is the maintenance man going over the lift truck controller

Asphalt Paint and Vitrified Tile Duct Resist Acid Fumes

By Earl Hertz

AFTER replacing, several times in the first year, the fume hoods and a goodly portion of the duct work used to exhaust the fume from the acid tanks in the cleaning and plating department the plant engineer decided that such heavy maintenance was too unattractive and decided to do something about it. He investigated thoroughly and then replaced his sheet metal duct work with vitrified tile of the proper size. Following this he had a series of uniform fume hoods made up of regular black iron construction but bolted together so that they could be easily disassembled if need arise.

He painted these hoods inside and out with asphalt paint of an acid resisting character and then kept track of the results. He found by renewing the paint once every three months he could keep the hoods in useful condition for over 1½ years and the tile appeared to have an indefinite life. He has since found a suitable acid proof paint which he claims will spread the painting operation to six months instead of three.

Disposal of Chaff

By Chester Milton

CONSIDERABLE CHAFF is liberated in the roasting of coffee beans and this chaff, if released in the atmosphere above the factory roof as is usually the case, collects over the roof, clogging the drains and creates a bad fire hazard. Several kinds of equipment were tried by one plant engineer to eliminate the condition on his roof without satisfactory results. He finally decided to burn the chaff in an incinerator and hit upon the idea of combining his incinerator with his dust collection system.

Fig. 1. Here is the cyclone dust collector with the fire box beneath it

At each roaster or battery of roasters was located an exhaust fan designed to take the chaff away from the roaster and convey it pneumatically to a cyclone dust collector on the roof. He then provided his cyclone dust collector with a brick jacket and constructed a small fire box beneath it as shown in the photograph. There were sufficient number of these units to warrant keeping a man on the roof to keep the fires under control in the combustion chambers and thus he

eliminated the previous bad conditions. Instead of cleaning large roof areas with a crew of men weekly the single man was able to take care of all the disposal of ash which was small as compared with the original volume of solids which was scattered about.

Proper Use of Signs Saves Time

By George Zohfeld

THE MANAGER of this manufacturing plant found his information lobby continually filled with people requiring repair parts. The time of a girl at the information desk was being absorbed by these inquiries and the work of directing the callers to the

Fig. 1. Two of the signs are shown in this picture

repair department. Since there was no particular reason for having these people apply at the main office lobby and information desk a sign was made and erected at the entrance indicating the repair department in one direction and office in the other. Thereafter those calling at the plant for repairs went directly to the repair department office and those seeking the office found that there was ample room in the lobby and that their needs were attended to promptly. Fifty per cent of the time of one employee was made available for other duties in the main office information section.

Welded Steel Soaking Pit Cover Shows Saving

By Richard G. Seehafer

SOAKING PITS used by some of the large steel mills exceed 40 ft in length and are 6 ft-6 in. wide. The older type cast iron construction weighs 8,000 lb, contains 300 insulating brick and a like number of high grade fire brick. The cast construction, besides being high in first cost resulted in spoilage of considerable brick lining due to expansion and warp.

The plant engineer of one steel mill cast about for a solution to his problem and decided to try a steel welded construction to replace the cast construction. He found that the welded cover weighed 3,400 lb less than the

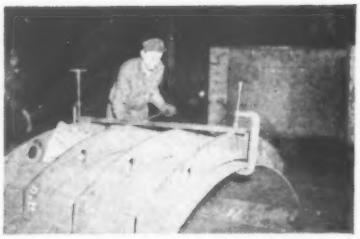


Fig. 1. This welded steel cover weighed less and outlasted its cast iron counterpart

cast cover and that it saved in bricking since the new design held its shape far better than the cast cover. His saving in first cost of the covers was 45 per cent plus a considerable saving due to longer life of the refractory and a further saving due to reduced handling cost of the covers in view of their lighter weight.

A More Economical Way to Store Stainless Steel

By Chester Aretz

A MANUFACTURER of household appliances using considerable polished surface stainless steel found that an unusually large amount of his product was being rejected in inspection due to scratches on the surface. Investigation showed that much of the damage was traceable to the stock room. Careless handling caused not only scratching of the sheets but also bent edges and dents were likewise produced. After a thorough study of the conditions the following method of storing and handling was evolved.

A series of steel racks were designed using angle iron frame members and pipe uprights. The uprights divided the rack into a series of sec-

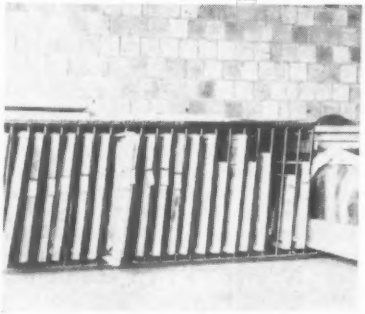


Fig. 1. The completed rack for storing stainless steel

tions each capable of receiving a shipping box of the stainless steel sheets as received. Each section of the rack was provided with steel rollers at the bottom. The rack was designed with a few degrees of slant so that the sheets in the boxes would lay compactly against each other while being moved in and out of the racks.

Before placing a box of sheets in the rack the top boards of one side were removed exposing the first sheet but the paper was carefully preserved over the sheet. The box was then placed with one end in the rack resting on the roller. It was then a one man job to push the box into the rack or pull it out for removal of sheets.

Rejects due to scratches, bent edges and dents in the stock room were reduced to practically zero and many man hours were saved due to the more efficient method for handling the sheets.

Ingenious Drive Arrangement Saves Belts

By James Ludwig

THE DRIVE involved a 5 kw dc generator for a battery charging set. The centers were so close (with the generator located directly above the driving pulley) that bearings ran hot from the belt tension and the belt lasted slightly more than a week. It was impossible to relocate the generator and, in order to lengthen out the drive, an

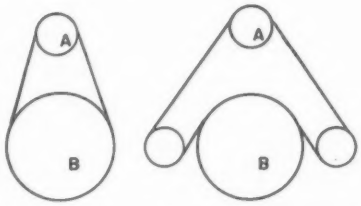


Fig. 1. This was the original arrangement of the drive. Fig. 2. Right. It was rearranged in this manner

ingenious arrangement was hit upon which resulted in the belt life being stretched out from one week to over a year.

Fig. 1 shows how the drive was arranged originally and Fig. 2 shows how the drive was rearranged. The driven pulley A and the driver pulley B were left just as they were. Two idler pulleys were mounted so that there was one on each side of the driving pulley B and the belt was brought down from pulley A around the idler pulleys and then up over the top of driver pulley B. Both sides of the belt were in use on pulley surface but this did not seem to affect the belt enough to cause objection. The saving was figured as that of belting only and amounted to one belt saved every week. Other savings consisted of maintenance time and idle time for the generator.

THE MOST efficient engine in the world is the Diesel, which delivers as high as 36 per cent of the power potential in its fuel, as against 30 per cent for the steam turbine, 24 per cent for the gas turbine and 8 per cent for the steam locomotive.

Questions and Answers

DO YOU HAVE TROUBLES? Send your questions to the Q & A Editor for answer. Readers are invited to answer questions printed without answers and to comment on those which are answered. Published replies will be paid for. Authors names and company connection will be withheld upon request.

High-Speed-Conveyor Operation

WE RECENTLY put in a rewound motor that had been burned out. This is a 17hp 970 rpm shunt wound, dc motor driving a bucket conveyor. When the plant electrician wired it up and threw the starting switch, it really started. I never saw a conveyor travel so fast. The roof shook like a young earthquake and the buckets were just a blur. We stopped it in time. So the electrician tried again—changed the connections and threw the switch. This time it ran backwards but not at high speed. With the third trial he evidently figured right because the motor ran as it should.

What made the motor go so fast? The motor itself sounded like the whine of a high-speed shell. I looked up the subject of shunt wound motors in my books but could find nothing that sheds light on this question.

Buffalo, N. Y. ROBERT BAKER

How to Repair a Concrete Floor?

Q. O. J. C., who lives in Illinois, not far from Chicago, has a maintenance problem on his hands and would appreciate help from those who have had experience along this line. He says: "The concrete floor in our plant is in very bad shape, and we thought possibly some reader might know of some material we could apply to this concrete floor without the necessity of tearing up the floor and building a new concrete floor. We might also add that our present floor is not very level so in certain parts of the plant it would be necessary to put more of whatever material we use than in other parts."

Wants to Build a Transformer

Q. I wish to construct a transformer for operation on 110 v ac The secondary should deliver a current of 40 amp at 4 v. Would someone kindly advise me what size core to use and how to proportion the size of wire and the number of turns in the primary and secondary?

W. B. LAUGHINGHOUSE
New York, N. Y.

Can He Connect 22-v Motor to Run on 110 v?

Can you give me any information on re-connecting a 220-v dc motor for use on 110 v so it will run at its normal rated speed and horsepower? In these days of limited equipment, we often are able to purchase the 220-v dc equipment, but as our current is 110 v we can only get half the capacity of the motor.

Waukesha, Wis. C. W. W.

How Prevent Fuses from Blowing?

All my 220-v power fuses, clear back to and including the main board, are 30 amp. An overload will frequently blow the fuses on the main board, putting all machines out of operation. We have renewable fuses.

Would it do any harm if I put in two 30-amp links in each of the main board fuses? All machines are protected individually by 30-amp fuses. If I did put in two links, how much would that increase the amperage? Twice, or more?

Peterborough, N. H. A. H. P.

Refrigerating Engineers, Please Note

Q. I would like to know what methods are used to test for moisture in ammonia and where in the compression system the test should be made? What methods are employed to remove moisture? Is there any manufacturer that specializes in this problem?

Detroit, Mich. H. T.

Copper Switches Corrode

What steps can be taken to prevent or reduce the corrosion effects of sulphuric acid fumes on our electric knife switches and electric circuit breakers?

Buffalo, N. Y. B. H. W.

Welding Precautions

Q. What are the usual methods used in welding practice to make certain that tanks having contained inflammable substances are free of dangerous vapors and gases?

Chicago, Ill. M. W.

A. The methods generally used vary somewhat with the nature of the materials involved and the circumstances under which the work is done. Where steam is available, it can be used to remove materials which are easily volatile. Washing with a strong solution of caustic soda or similar chemical will remove heavier oils.

Even after thorough cleansing, the container should wherever possible, be further safeguarded by filling it with water before any welding, cutting, or other hot work is done. In practically every case it will be found possible to place the container in such a position that it can be kept filled with water to within a few inches of the point where welding or cutting is to be done. In doing this, care should be taken to make sure that there is a vent or opening to provide for the release of heated air from inside the container. This can usually be done by opening the bung, handhole, or other fitting which is above water level.

Where it is not practical to fill with water, carbon dioxide or nitrogen may be used in the vessel for added protection. Periodic examination of the gas contents of the vessel or container should be made from time to time to make sure that the concentration of carbon dioxide or nitrogen is great enough to prevent the occurrence of a flammable or explosive mixture. The air or air-gas mixture inside any containers can be most easily tested by using a suitable gas detector.

The carbon dioxide concentration should be at least 50 per cent in the air space inside the container, except that if the presence of hydrogen or carbon monoxide is detected, the carbon dioxide concentration should be 80 per cent or more in the free space. If nitrogen is used, the concentration must be at least 10 per cent higher than the concentration specified for carbon dioxide.

The reason for using carbon dioxide or nitrogen in an apparently clean container is that there may still be traces of oil or grease under the seams—even though the vessel may have been cleaned and flushed with caustic soda solution. The heat of the welding or cutting operation may cause such oil or grease to give off flammable vapors to the extent that an explosive mixture may be formed inside the container. *Precaution:* The use of carbon tetrachloride in place of carbon dioxide or nitrogen is not

recommended as carbon tetrachloride gives off a poisonous vapor when heated.

Make sure that jacketed containers or other hollow parts are sufficiently vented before heating, welding or cutting. Remember that air or any other gas which is confined inside of a hollow part will expand greatly when heated. The internal pressure created may be sufficient to cause the part to act like a bomb.

A metal part which is suspiciously light is hollow inside, and should be drilled to vent it before heating. Every possible precaution should be taken with jacketed vessels, tanks or containers to vent the confined air sufficiently before doing any hot work.

Solid Equivalent of a Stranded Conductor

Q. How can I determine the equivalent size in a solid conductor of a stranded wire? As an example, what is the solid conductor equivalent of a stranded conductor with seven No. 12 wires? The wire tables do not give this and I wonder whether anybody could refer me to a formula by means of which I could calculate it.

Lynchburg, Va. JACK ADAMS

The Arithmetic is Not Difficult

An answer to this question can be readily obtained by well known fundamental calculations. Given any group of circular conductors the total area is:

$$\pi(d^2/4)n$$

where d, the diameter of each strand in some units, usually in mils (one-thousandth of an inch), and, n is the number of strands in the cable. The total area will be either in square inches or square mils depending on the unit used for expressing d. When total area is obtained, the solid equivalent conductor may be obtained directly from a table or the actual diameter by calculation. If we call the total area A and the diameter of the equivalent solid conductor D, we can write:

$$A=\pi D^2/4 \text{ or } \pi d^2 n/4$$

then equaling these two, and, since $\pi/4$ occurs in each expression we can eliminate this part from each one and write, $D^2 = d^2 n$ for the equivalent areas.

Taking the example given, a cable made up of seven No. 12 wires, we find from a wire table that d is 80.81 mils. Therefore d^2 would be 80.81×80.81 or 6530 (known as circular mils) and the total cable area will be 7×6530 or 45,710 circular mils.

This total value indicates a solid conductor which lies between No. 4 (41,740 circular mils) and No. 3 (52,640 circular mils). The actual diameter of a conductor having an area of 45,710 circular mils can be obtained by taking the square root of this value, which is 213.79 mils. The respective diameters of No. 4 and No. 3 solid conductors are, 204.3 mils and 229.4 mils. In inches the diameters of the solid conductors would be 0.21379, 0.2043 and 0.2294. This illustrates the advantage of using the mil unit and avoiding thereby the decimal details.

C. O. VON DANNENBERG

Brooklyn, N. Y.

Plant Engineer's Digest

Prevention of Skin Infections from Cutting and Soluble Oils

By J. T. BEARD, JR.

Staff Engineer,
Socony-Vacuum Oil Co., Inc.

IRRITATIONS which sometimes appear on the skin of machine tool operators where cutting and soluble oils are used are the exception rather than the rule. In most cases no such trouble is experienced unless the operators are careless or the products are carelessly handled. Where infections develop, they are secondary to the primary irritations and are traceable to many causes not directly associated with the cutting fluid.

Until recent years it has been common practice to lay the blame for skin troubles arising from the use of these products on harmful bacteria which they were believed to contain. The fallacy of this supposition is evident (if one makes) a brief review of the processes employed in the manufacture and handling of these products. In the handling and shipping of cutting and soluble oils, every precaution is taken to prevent their contamination with foreign matter. Drums and tanks are cleaned thoroughly before they are filled.

Thus, the question naturally arises, "How does the use of cutting and soluble oils contribute to skin troubles?" These troubles are usually traceable to the careless handling and application of cutting fluids.

Generally speaking, the various types of skin troubles which are encountered with the use of cutting fluids are as follows: 1. A dry and subsequent cracking of the skin. 2. Pimples and, in some cases, boils. 3. A burning or irritation of the skin. 4. An inflammation of the skin, followed by the appearance of vesicles and later by open sores.

It is sometimes noted that operators who are constantly in contact with cutting fluids are troubled with a drying and cracking of the skin. This trouble is generally encountered where very light-bodied cutting oils are used, such as are commonly encountered in the machining of aluminum and magnesium. The use of solvents, such as naphtha or kerosene, to cleanse the hands of oil and grease, is also contributive. These light-bodied oils and solvents dissolve the natural fat that keeps the skin soft and pliable. Since this trouble is not caused by bacteria, the use of germicides will not correct the situation. One of the preventive measures applicable here has been found to be the use of a suitable emollient such as lanolin. This is applied to the skin after it has been cleaned thoroughly with a mild, non-irritating soap and water.

When operators are troubled with pimples or boils, these usually are caused by the activity of harmful bacteria which have contaminated the cutting fluid in service or are normally present on the skin. In order to understand how this contamination occurs, it is necessary to analyze the situation in detail.

In removing metal by turning down a bar of steel, for example, one of the functions of a cutting oil is to cool and lubricate the cutting tools and thus prevent their breakdown and the consequent marring of the surface finish of the work. That a cutting fluid is able to do this lubrication job is due to its exceptional penetrating properties which enable it to creep into the extremely small space between the tool and the work piece. This space is created momentarily by the minute vibrations of the tool and is microscopic in size, its width depending on various factors, including the nature and condition of the metal that is being cut. Obviously, if the fluid can penetrate these microscopic openings, it also can penetrate the pores of the skin.

One of the important initial sources of these troubles is the bacteria that normally exist on the human body itself. Medical authorities state that more than fifty distinct and different harmful bacteria have been found on the arms and hands of the average clean, healthy individual. These bacteria are perhaps the most important source of primary irritations, the cutting oil itself acting merely as a carrier of the germs from the surface of the skin, where they are quite harmless, into the pores where they germinate and produce pimples, sores and rashes. Where soluble oils are

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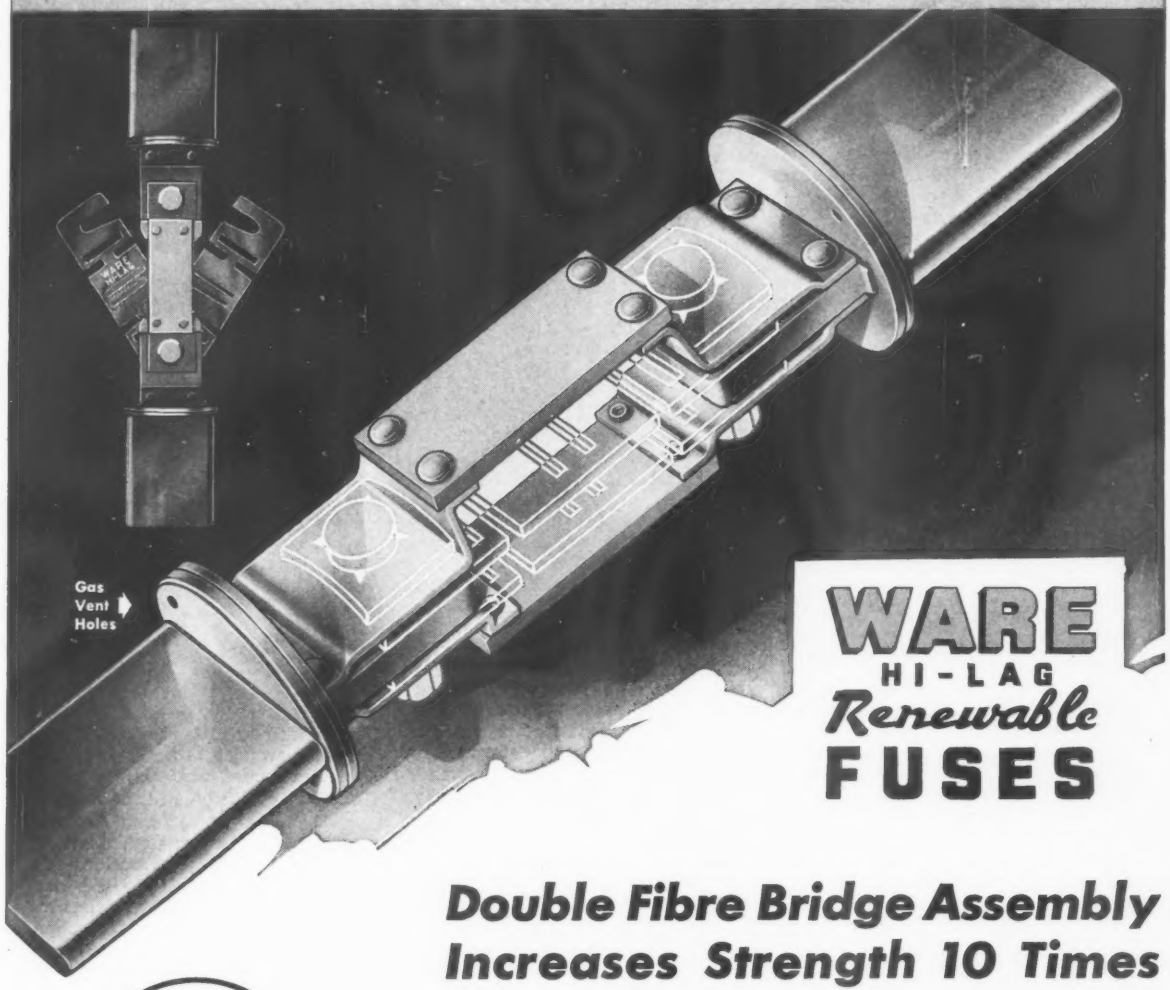

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Double Fibre Bridge Assembly Increases Strength 10 Times

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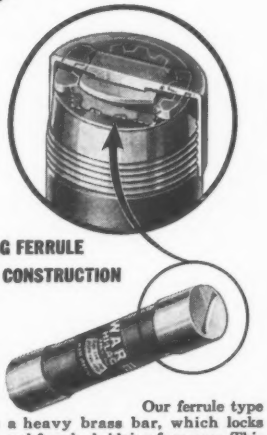
Perfect alignment is always maintained in this knife blade assembly with links centered in casing. The links are quickly and easily replaced or removed by loosening the nuts and slipping in or out.

We manufacture all of our own parts and are making prompt deliveries.



HI-LAG FERRULE FUSE CONSTRUCTION

Our ferrule type fuse has a heavy brass bar, which locks into open end ferrule, bridging fuse case. This bridge locks link to prevent twisting and cap tightens on new center contact. No sagging washers or twisted links to cause overheating.

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used as cutting compounds, one of the important sources of bacteria is the water which is employed for emulsification.

Secondary infections frequently are of a serious nature. The introduction of bacteria into the primary rashes and sores or into cuts or abrasions on the skin of operators results frequently in the development of painful boils. Infections of this sort require frequent medical attention and impair the efficiency of the operators.

Primary or secondary skin infections can be prevented or eliminated by the strict observance of proper sanitary conditions, which provide for: 1. Proper care and handling of the cutting fluid itself. 2. Proper cleansing of the skin of the operator and avoidance of use of oil-soaked or dirty clothing. 3. Proper protection of the pores of the skin. 4. Proper selection of employes who work in cutting fluids.

Keep Oil Clean

Drums and tanks of cutting or soluble oils should always be kept well covered in order to exclude foreign material of any kind. Operators, moreover, should be instructed to keep their arms and hands clean and should not be permitted to expectorate into oil pans or drains. Every precaution should be taken to maintain the original cleanliness of the cutting or soluble oil.

Operators should not only be encouraged but instructed to protect themselves by keeping their skin clean. They should wash their arms and hands thoroughly with soap and hot water before starting their shift to remove harmful bacteria that might cause infections. If showers are available, operators should be encouraged to use them. It is good practice after washing to protect the skin from infection by filling the pores with lanolin or other ointment. At the end of a shift operators should again thoroughly wash their arms and hands with soap and hot water before going home. Harsh, alkaline or abrasive soaps or solvents should be avoided as these can cause dermatitis.

Use Clean Towels

Since cutting or soluble oils can carry germs not only into the pores of the skin but also into cuts, abrasions and skin rashes, any sores of this nature should receive prompt attention. To prevent scratching, it is always advisable to avoid the use of hard, stiff cleansing brushes which scratch or break the skin. The use of waste or rags for wiping cloths is undesirable since they frequently contain chips and metallic particles that produce scratches. Dirty wipe cloths are directly responsible for innumerable cases of infections and their use should be prohibited. Only clean, individual towels should be permitted.

Cleanliness in the matter of clothes is important. Operators should always change from their street clothes to working clothes before going home. Working clothes should be washed thoroughly at least once a week and underwear should be changed at least as often. Dry cleaning or solvent cleaning should be avoided.

Every system should have some means for filtering cutting oil and thus removing fine metallic particles that might scratch or puncture the skin. Not only is this advisable from the standpoint of minimizing skin irritations but also from the standpoint of securing the most satisfactory surface finish on the manufactured parts. In some plants an arrangement is provided for sterilizing the cutting fluid. This is done by heating the fluid to a temperature of 140 F and holding it at that temperature for a half hour to two hours. For cutting oils the temperature is then raised to 280 F for approximately two minutes, after which the oil is returned to the storage tank for re-circulation. When soluble-oil emulsions are sterilized, the temperature should not be permitted to exceed 140 F in order to minimize any tendency of the oil to separate from the emulsion.

If a cutting-fluid system is found to be contaminated, half-way measures of purification are rarely effective. The surest and safest procedure is to remove the cutting oil or soluble oil completely from the system, after which the tanks, piping and machines should be thoroughly cleansed, using a suitable disinfectant or germicide. New or sterilized oil may then be installed.

In many plants where large central systems supply cutting fluids to groups of machines, disinfectants are commonly employed in order to prevent the growth of harmful bacteria. Generally speaking, the advisability of adopting a disinfectant is dependent upon the particular conditions encountered. The use of disinfectants, however, may lead to carelessness on the part of shop men to such an extent that personal cleanliness will be neglected and the liberal use of soap, hot water and clean wipe cloths will be ignored. The use of excessive quantities of a disinfectant, moreover, may lead to skin irritations. Where disinfectants are used intelligently, however, they are an effective means of minimizing skin infections.

Central Manufacturing District Magazine

Sound Business

EVEN A LOUD NOISE may have its uses. Industrial application of sound waves has received new stimulus with the erection, by Ultrasonic Corporation of Cambridge, Mass., of a unit to precipitate carbon black for Godfrey L. Cabot, Inc. This pilot unit has been so successful that other industrial applications are being investigated.

The terms "supersonic" or "ultrasonic" are sometimes used to designate sounds too high in pitch to be detected by the human ear. Although ultrasonic sound has many industrial applications, the new carbon-black collection unit employs an extremely efficient generator of intense audible sound. The sound a few feet from the new generator is over a hundred times as intense as the noise from a 2000-hp aircraft engine running "wide open" in a small room. Commercial production of such a sound is made possible by a siren which is capable of converting as much as 50 per cent of the available energy in compressed air into sound, whereas an ordinary fire-engine siren has an efficiency of less than one per cent.

Dust Particles Form Aggregates

Sound waves involve successive compression and rarefaction of the air. Because extremely small particles suspended in air tend to follow this movement, while larger particles remain relatively still, sound waves cause collision of the small particles with the large ones. Although the amplitude of these vibrations is extremely small—generally less than a thousandth of an inch—it is sufficient to give particles a push equivalent to twelve million times their own weight. Under proper conditions the dust particles will adhere to form aggregates containing as many as several hundred primary particles, which may then be collected in a standard separator. In general, the finer the particles of a suspension, the more readily are they coagulated by the sonic method, hence greatest use will be in fields where the dust particles are smaller than ten microns, or about as fine as face powder. The agglomerates of carbon-black particles issuing from the combustion chamber are in this range and the sonic apparatus reportedly collects them as efficiently as a dry electrostatic precipitator, with a cheaper installation. Other fields where the method appears promising are in the precipitation of acid mists and tar fogs, which are difficult to handle by other methods.

Natural fog is another program that may yield to sonic precipitation, although work is still in the experimental stage. Preliminary tests for the Navy indicate that power consumption may be great, but is still only about one-tenth the amount consumed as fuel by the FIDO installa-

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NOW AVAILABLE IN 217 CITIES FROM COAST TO COAST
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TYPE AK-1, AC ONLY
MEASURES BOTH VOLTS AND AMPS
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Here's a lightweight, low-cost tester for which you'll find a multitude of uses . . . and now it can be on the way to you as soon as your order is received. Warehouses across the country are stocked, and distributors and agencies are equipped to fill your order promptly.

Actually, the AK-1 gives you six instruments in one because it has six ranges: 0-15/60/150/600 amp and 0-150/600 volts (for a-c circuits only). Just hook it around a conductor, flip the selector switch to **AMPERES**, and there's your current measurement. For voltage measurements, all you do is connect the voltage leads, snap the switch to **VOLTS**, and take the reading.

Among its many uses, the AK-1 is ideal for motor testing. No cutting of conductors, no interruption of service . . . yet in a jiffy you *know* whether your motors are overloaded or underloaded to a wasteful degree.

We're sure you'll agree with the hundreds of AK-1 users who say, "It's the handiest instrument we've ever used." See your nearest G-E apparatus distributor or agency today, or write for Bulletin GEA-2950 to get complete details on this versatile instrument. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

GENERAL ELECTRIC

602 112

tion, which burns the fog away with flame.

Use of Other Effects

Other physical and chemical effects of sonic and ultrasonic vibrations may be utilized for a wide variety of applications—a material may be dispersed into the colloidal state or coagulated from it, large molecules may be broken down into smaller ones, or certain chemical reactions may be accelerated. A short exposure to an intense sound field has accelerated the aging of whiskey, with a distinct improvement in odor and flavor. The operation of spray driers may be improved by an increase in the transfer of heat from the hot gas to the spray droplets. Investigation of the use of sound to improve the formation of sheets of paper by shaking the water out may lead to a similar application for the drying of textiles.

Further Studies

With the development of jet planes, which create high-intensity sound waves, the physiological effects of sound are being investigated. The new generator will be used to determine human limitations and reactions. Although no lasting ill effects have been encountered from short exposure to high-intensity sound, nausea, headaches, and a painful sensation in the ears have been observed. There is also a temporary decrease in the sensitivity of the ear to the frequency to which it was exposed, comparable to the decrease in color sensitivity of the eye after staring at a certain color.

For those who picture the future industrial world as filled with screaming sirens, it may be noted that the shielding effect of the steel walls enclosing the sound generator is sufficient to lower the noise level outside the present pilot installation to that of a noisy business office.

Arthur D. Little, Industrial Bulletin.

What's the Difference between, Bolts, Bolt-Studs, and Studs?

By J. E. STARK, Crane Co.

THE INDISCRIMINATE use of the words "bolts," "bolt-stud," and "stud" is often the cause of confusion in specifications or requisitions.

A portion of this confusion can be charged against the peculiarities of the English language, because, in its general sense, the word "bolt" can be construed as including the other two words. For example, we speak of "bolting" or of a "bolted" joint, and those terms are correct whether they refer to bolts, to bolt-studs, or to studs. However, when specifying or ordering these articles, the use of the correct word is essential.

Bolts

The Crane catalog defines the word "bolt" as: A bolt is threaded on one end only, the other end being upset into the form of a head.

Fig. 1 shows the type of bolt that is most commonly used in the valve and fitting industry for flanged joints in piping systems, for flanged bonnet joints on valves, and for bolted fastenings in general.

The official name of these is "machine bolts," and orders, inquiries, specifications, etc., should designate them by that name.

Bolt-studs

The Crane catalog defines the word "bolt-stud" as: A bolt-stud is threaded either on both ends or full length, to the standard diameter for nut assembly on each end.

"Why a bolt-stud? Why not use a bolt?" There are several answers to this question:

1. At times, there is not sufficient clearance at the back of a flange to permit passing a bolt through the bolt hole from the back. In such instances, a bolt-stud can be passed through from the face of the flange, and a nut can then be screwed on the bolt-stud at the back.

2. Long bolts are sometimes difficult to procure, whereas long bolt-studs can be made in almost any shop by threading bar stock.

3. The alloy steel bar stocks best suited for high strength bolts are given heat treatment by the producers. If subsequently formed into bolts, these steels usually require additional heat treatment after forming and if this is not expertly done, the bolts may not possess the desired properties. On the other hand, bolt-studs have the same properties as the bars from which they are made.

4. The distribution of stresses in a bolt is not so favorable to high strength characteristics as is the case with a bolt-stud.

Studs

The Crane catalog defines a "stud" as: A Stud is threaded on both ends, one end being oversize in diameter to fit tightly (wrench fit) in a tapped hole, the other being to the standard diameter for a nut assembly.

Studs are used when the clearance at the back of one of the flanges to be bolted together is not sufficient for a bolt-head or a nut. In designing products, engineers often resort to studs in order to reduce the size and bulk of flanges. Except in special cases, a stud requires only one nut, as one end is screwed into a tapped hole in another part.

Although not used by Crane Co., the term "stud-bolt" is sometimes encountered. It usually means "bolt-stud," but this is not always true. For that reason, the use of the term should be discouraged.

The term "through bolt" is frequently used to designate a fastening member that passes through the parts fastened. The term applies to either bolts or bolt-studs; obviously, it does not apply to studs, because a stud passes into (but not through) one of the parts fastened.

To repeat, in preparing orders or requisitions for bolts, bolt-studs, or studs, be sure to specify them correctly, as explained above.

Valve World

Building . . . with Explosive Rivets

BY WILLIAM REYNOLDS

EXPLOSIVE RIVETS are "blind fasteners," meaning that the entire fastening operation can be completed from one side only. They are originally produced for the construction of military aircraft. Today they are used in the assembly of such diverse items as heavy duty trucks and delicate analytical balances.

An explosive rivet has a small cavity extending the entire length of its shank. A minute amount of explosive in this cavity is detonated by a simple, heated tool similar to a soldering iron. Firing the charge causes the shank to expand, forming a large barrel-shaped "shop head," which makes a strong, permanent fastening.

The cost of explosive rivets is higher than solid rivets or screws but this is offset by the speed with which they can be set—15 to 20 per minute. The advantages of the Du Pont riveting irons are also an economy factor. Other savings are often possible through new design possibilities which takes advantage of the blind riveting.

In the case of a large trailer manufacturer who was putting together the interior body panels with screws which frequently worked out. The substitution of explosive rivets has eliminated loose and wavy panels and reduced maintenance costs.

To meet varied requirements, brass, copper, and several aluminum alloy type rivets are manufactured. Two head types, brazier and 100 deg counter sunk, and three diameters, ⅛ inch, 5/32 inch, and 3/16 inch, are available. Various lengths make it possible to fasten materials from .010 inch to .510 inch in thickness; yet, wide grip range of each rivet size means that users need not carry large stocks of assorted length rivets.

Dupont Magazine

FROM THIS UNIFORM WALL TUBING . . .
This piece of plain tubing was formed from a sheet having uniform thickness within ±.0005" . . . The seam fusing the edges of the sheet into a tube is *stronger than the sheet itself*, and as workable in every respect. Here is the uniformly high-strength tubing used to make Rex-Weld Flexible Metal Hose from bronze, steel, stainless steel and other alloys.
±.0005
REX-WELD IS FORMED ON A "50-50" BASIS
Rex-Weld corrugations are formed on the exclusive CMH "50-50" basis—each corrugation is half-formed on each side of the plain tube diameter, instead of being fully formed outward or inward. This reduces stresses in the tubing and produces corrugations having *uniform* wall thicknesses within each corrugation, and in relation to one another.
FLEXONICS * TECHNICAL DATA

to maintain UNIFORM Strength . . . in your FLEXIBLE METAL HOSE!

You can be sure that each type of Rex-Weld Flexible Metal Hose will give full service value within its rating because *there is no guesswork* in the construction of this multi-purpose hose . . . Every operation—from original design to final inspection—is performed within known factors of material strength and flexibility.

Uniformity of wall thickness in Rex-Weld hose allows exact evaluation of its service ability in your plant . . . There are no thin spots or undetected strains to bring early and unexpected failures in service . . . and the exclusive CMH method of forming corrugations provides full flexibility and high resistance to metal fatigue without weakening the basic tubing.

Full data on the many different types of Rex-Weld Flexible Metal Hose in sizes from 3/16" to 12" I. D. and lengths to fit your needs is available. Write for it today.

Some Plain Facts on Metal Tubing . . . Flexible and Otherwise

All CMH Rex-Weld Flexible Metal Hose is made from tubing formed out of flat strips of the various metals used, and is seam-welded at the strip edges to produce a tube of uniform strength, thickness and flexibility. There are a number of reasons for using this type of tubing as a basis for Rex-Weld; *but most important is that only in this way is it possible to be sure of uniform wall thickness in the finished product.* Other methods of manufacture cannot—as yet—hold tubing to nearly as close tolerances as the rolled strip from which Rex-Weld is made.

- Laboratory tests show that when Rex-Weld samples are subjected to abnormally elevated pressures, failure of the tubing occurs at undeterminable points anywhere in the tube.
- CMH choice of seam-welded strip is solely on the basis of findings of its superiority for use in top quality flexible metal hose.

*The science of FLEXONICS . . . "the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion" . . . is exemplified in the basic products of Chicago Metal Hose Corporation.

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Plant Engineer's Digest

Vacuum Tube Acceleration Pick-Up

A NEW electronic tube, in appearance much like an ordinary radio tube, but capable of measuring accurately the rapidly changing accelerations to which various parts of an airplane are subjected in flight, has been developed in the Engineering Mechanics Laboratory, National Bureau of Standards, under the direction of Dr. Walter Ramberg.

The vacuum-tube acceleration pick-up takes advantage of the effect of acceleration on the relative position of the electrodes in the tube. This is in contrast to the design of conventional tubes where this effect is suppressed as much as possible because it leads to electrical noise and microphonics. The tube contains a fixed, indirectly heated cathode with two plates, one on either side. The plates are elastically mounted to deflect in response to acceleration normal to the plane of the plates. Deflection of the plates causes a change in plate current proportional to the acceleration and such changes in current are recorded on a standard oscillograph.

The elastic mounting of the plates was designed to give a fundamental frequency of about 800 cycles per second, in order to make the tube capable of recording accelerations with frequencies up to 200 cycles per second. Tests conducted at the Bureau on the latest type tubes (of which 95 have been built) have proven them to have the desired natural frequency with an output proportional to acceleration normal to the plates. The output for an acceleration of the order of 10 times gravity was of sufficient magnitude to record directly on a standard oscillograph without requiring an auxiliary amplifier.

The fundamental frequency of the plate structure for bending normal to the plate was computed by treating the structure as an elastic system with a concentrated mass at the center of gravity of the plates and distributed masses in the supporting wires, which are subject to flexure and torsion by vibration of the plate normal to its plane. The diameters and lengths of the wires were computed to give a fundamental frequency in this mode in the range of 750 cycles per second. The natural frequencies of vibration in other modes were estimated to be much higher.

The fundamental frequency was determined experimentally by connecting the pickup into a Wheatstone bridge with a cathode ray oscillope, tapping the pickup with a pencil or finger, and matching the output on known frequency for an audio oscillator.

The development of the vacuum-tube acceleration pick-up was begun in 1941 for the Navy's Bureau of Aeronautics and was carried on with the cooperation of Sylvania Electric Products, Inc.

National Bureau of Standards

Slime and Algae in Air Conditioning Systems

WHILE THE PROBLEMS of scale and corrosion are of major importance in the water systems of air conditioning units, particularly during the summer months, slime formation may be the primary cause of frequent interruptions in operation. The growth of slime and algae may reach such proportions as to necessitate frequent shutdown. Clogging of circulating pump screens and nozzles may require cleaning as frequently as every 24 hours where severe sliming is encountered.

Slime formation is less frequently the major problem in heavily-concentrated industrial areas where atmospheric pollution is high. In such areas, the absorption of acidic gases from the atmosphere presents a severe problem of acid corrosion of metal surfaces, but slime formation is rarely as critical a problem as in less industrialized or more rural areas.

Baccilus subtilis (hay bacteria) is one of the slime-forming bacteria most frequently encountered and, of course, contamination by this means is more common in less industrialized localities.

Slime formation in air conditioning units is usually caused by air-borne bacteria rather than those introduced with the make-up water. Consequently, these troublesome organisms are being constantly replenished by the outside air introduced into the system. Even if all bacteria present in the circulating water are destroyed by chemical treatment, a fresh supply of offending organisms is immediately introduced with the incoming air. Unless the killing treatment concentration can be continuously maintained to dispose of the fresh organisms continuously introduced, slime formation will immediately recur.

Effective Concentration

Maintenance of a toxic treatment concentration continuously in the circulating water is not only difficult for many reasons, but may also be undesirable under certain circumstances. Dependent upon the point of view, it may be considered that certain bacteria gradually develop an immunity to the treatment and thrive in spite of treatment concentrations that were originally effective. It may also be considered that when treatment was originally introduced, all but the most hardy species of bacteria were destroyed, leaving only a few of the more resistant strains. These remaining bacteria gradually multiply and develop slime in spite of treatment concentrations that were originally effective. Regardless of which theory is used, the actual practical results are the same;—namely, treatment concentrations which at first were highly effective eventually lose their power to control slime formation.

It is customary, therefore, in treatment for the prevention of slime, to vary both the toxic agent employed and the concentration used. In cooling tower systems, where the air contacting the treated water is not later used for human consumption, there is wider latitude in the choice of algicides than where the treated water contacts the conditioned air. In these latter cases it is most important that no odor be imparted to the air to cause difficulties or complaints by the plant personnel.

Chlorine is not very effective for use in the prevention of slime in air conditioning units because of aeration of the chlorine from solution passing through the sprays and also because effective chlorine concentrations in the circulating water would impart a chlorinous odor to the conditioned air.

Odors and Toxic Effects

Sodium pentachlorphenate, another ordinarily effective algicide, is likewise limited in its application to air conditioning systems. Toxic concentrations in the circulating water tend to produce an irritating odor to the conditioned air. Concentrations sufficiently low as to provide no objectionable odor may not be sufficiently potent to control the biological growths encountered in that system.

Heavy metal salts such as the salts of mercury, silver and copper are, in general, applicable for control of slime growths, but mercury salts in particular must be carefully controlled because of their marked toxicity in humans. Various oxidizing agents such as the permanganates may exert a marked bactericidal effect, but may produce undesirable reduction products such as manganese dioxide.

The control of slime formation in air conditioning units requires careful study of each individual case rather than the application of any single toxic chemical. The problem is individualized not only to the toxic chemicals required, but also to their concentration, frequency of application and frequency of alternating one algicide with another.

The Betz Indicator

Material Handling in the Structural Shop

By E. O. THOMAS,
Thomas Machine Manufacturing Company,
Pittsburgh, Pa.

MATERIAL handling in the structural shop has long been a problem that has received too little serious consideration. It is obvious that every plant presents a different problem but the various types of material-handling equipment in use today, in most cases, is standard and the problem thus becomes a matter of selection, application, and suitable arrangement of equipment.

A substantial portion of labor cost can be charged to material handling. For this reason those charged with the responsibility of economical production must always be aware of the fact that it costs money to move material, whether it be from the storage yard to the shop, from one machine to another during the process of fabrication, or through a punch during punching operations. Very definite and practical plans must therefore be incorporated in any shop arrangement to control the movement of material from the storage yard to the loading area.

First take a look at the storage yard. It should be large enough to permit the storage of material according to type and size, and arranged so that it can be readily identified. It should never be necessary to move material until required for use in the shop. In many shop arrangements it is advantageous to perform most shearing operations before the material enters the shop for further fabrication. The equipment for doing this work should be so located that the material, after shearing, can move readily into the shop in a straight line. Each individual machine in the storage yard should be equipped with a suitable independent crane.

From the storage yard, the material should move directly to the layout floor or equipment required for the next operation. It is important that suitable independent cranes be provided for the layout or marking floors.

Arrangement of shop equipment should be such that material can move freely from one machine to another during the process of fabrication without any backward motion.

As an example, there is one structural shop of modern design in which particular attention was paid to material handling facilities. Twenty-five overhead cranes operating transversely, lift the material from buggies moving longitudinally through the shop from the material storage yard to the various tools which are located between the tracks. The overhead cranes are equipped with 5-ton electric trolley hoists which are controlled from the floor. Arrangement of cranes is such that electric trolleys can be transferred from one to the other so that heavy lifts can easily be handled. This system of crane service covers the entire shop area and provides economical and efficient service for each individual machine.

In addition to the provision of efficient facilities for moving material through the shop, there is the problem of handling material through the various punching operations. Compare the time it actually takes to punch a hole with the time it takes to properly locate the material before punching and you have the answer. Here the time element is a most important factor in addition to the labor factor. Therefore, in all production shops serious consideration should be given to the installation of spacing tables or material handling tables.

The matter of selection depends entirely on the volume and type of work the shop is designed to produce. For the smaller shops doing miscellaneous work, handling tables are in most cases sufficient. In shops with a capacity for large tonnage of duplicate pieces, hand operated or full automatic spacing tables are indispensable. A spacing table is nothing more than a material handling table with a carriage to pull the material through the punch and designed to handle a variety of plates and shapes. Spacing can be obtained in a number of ways; by matching a pointer on the carriage with a strip temple mounted on the table, by fixed stops set at the desired spacing, or by

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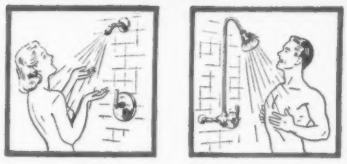

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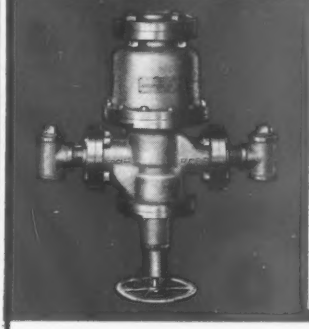

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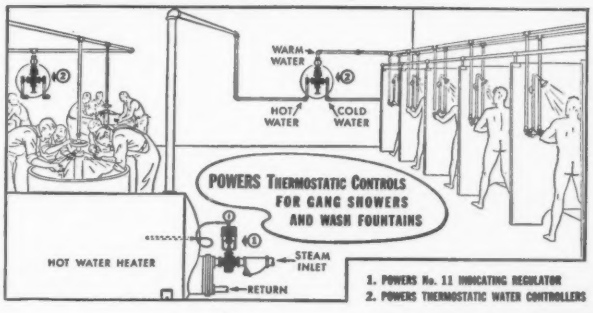

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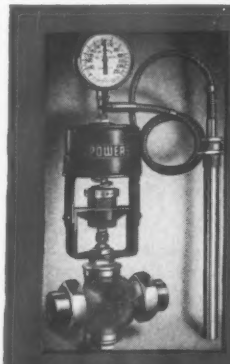

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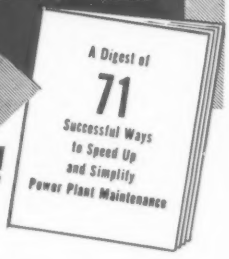

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Plant Engineer's Digest

a stopping mechanism actuated by templet pins sets in a strip templet at the desired spacing.

The advantages of spacing table equipment is obvious. Material handling is reduced to a minimum. Layout work is eliminated. Accurate and fast punching is assured. One particular advantage to be noted from the use of spacing tables is the fact that no accounting is necessary for stretching of material during punching. In the old method of punching to centers, the templet marker had to allow for stretch and this allowance was based on previous experience which was often most inaccurate. With the use of spacing tables, whatever stretch occurs is thrown to the rear and can be sheared off after punching. This equipment can be designed to cover any specific requirement in many industries.

For a Firm Footing

THE MARKET FOR FLOORING materials is a large and attractive one, especially as building activity increases. New materials are continually being introduced; in the past month the first large-scale production of plastic floor covering was started. The new materials usually excel in at least one characteristic, such as durability, appearance, or economy, and users have an opportunity to meet their specialized needs.

A recently-introduced plastic floor covering uses a vinyl-resin base on a felt back, and is sold in roll form. It is expected to be extremely durable, since resistance to abrasion and to acids and alkalis is an outstanding characteristic of vinyl resins. It costs somewhat more than standard-gauge inlaid linoleum, and about three times as much as the felt-base floor covering most commonly used. If vinyl floor covering should prove in time to be worth its price, it will offer an important market to chemical companies producing the resin itself.

Another new flooring compound is based on ethyl cellulose, and can be sprayed on wood or concrete to the thickness of a heavy paint film, or can be troweled on to greater thickness if desired. It is in the low-cost range, about 25c a square foot installed, and is said to be impervious to chemicals, oils, and water, an important feature for many industrial installations. The surface has a leather-like texture, but can be polished. The ease of applying and maintaining this coating by spraying is one of its special features; another is that it can be made electrically conducive. Plans for large-scale manufacture and distribution are now being formulated.

A flooring which has been available for a few years has the remarkable property of killing germs and repelling cockroaches. This material called "Hubbelite" and consisting of magnesium oxychloride cement, contains a copper compound which is apparently responsible for its biological powers. The flooring is not roach-proof, but roaches definitely avoid it. It is recommended for food plants and commercial kitchens, and may prevent infection where bare feet are common, as in locker rooms and institutional shower baths.

The most common industrial flooring is asphalt, which costs from 20 to 47 cents a square foot, depending on whether it is troweled on or laid in tiles, and whether it is treated to be resistant to oil and grease. Ease of maintenance, and a warm, resilient, non-skid surface are advantages; asphalt's poor reaction to excess moisture and industrial solvents, its brittleness when cold and its softness when hot make it impractical for some installations. Where radiant heating through an asphalt floor is used, furniture-rest devices should be used to protect against indentation of the surface.

Concrete Flooring

In installations where radiant heat is supplied through hot water or steam, the pipes are imbedded in a concrete subfloor; where hot air is used, it is carried in precast hollow concrete blocks. Concrete is also commonly used as the visible flooring, as well as the sub-floor where traffic is heavy, and where appearance is not important. Although chlorinated-rubber-base paints, pigment colors, and acid stains are available to color concrete floors, they soon wear off under traffic. Concrete is cheap to install and maintain, and is a good heat and sound insulator; light-weight cellular concrete, honeycombed with air cells, is durable and as light as wood. Nails can be driven into some forms of concrete, and slabs of cork and concrete are made especially for flooring. Floors of concrete are, however, so rigid that they are tiring to stand on or walk on, and they are susceptible to moisture, acids, and alkalis. Preparations to stop the "bloom" or cloudiness caused by moisture and the tendency to dust are not entirely effective.

Rubber tile, although expensive, is increasingly popular. Being nonporous, it is impervious to dirt and moisture, and it also resists fire, acids, alkalis, and most stains. Although resilient enough to be comfortable underfoot, it has negligible expansion and contraction characteristics; thus, where any significant change in the underflooring occurs, the rubber surface suffers. Rubber flooring cannot

be used in plants or kitchens where oils and greases may be absorbed by the rubber, with a subsequent softening of the floor.

Experts think well of the traditional hardwood floor where traffic is not heavy, as in a home. If the subfloor is sound, a wooden floor is warm, resilient, and quiet, and is not dented by heavy furniture. Installation cost is less than for many floorings, but continual waxing is needed and unusual wear leads to high refinishing expense.

Arthur D. Little, Industrial Bulletin

Shrinking of Machine Parts by Means of "Dry Ice"

THE PRACTICE of shrinking engine parts together is almost as old as the art of engine building itself. Manufacturers realized very early that the expansion and contraction of metals under different temperatures could be put to practical use for obtaining tight fits between parts of machines, such as wheels and cranks on shafts, crankpins in crank disks and numerous other similar applications.

Since the time that it became possible to make "dry ice" (solid CO_2) on a commercial basis the procedure of cold shrinking has become greatly simplified. "Dry Ice" (a trade name used by Pure Carbonic, Inc.) has a temperature of -109 F which is, of course, much lower than the temperature of a mixture of ice and salt which has a minimum of about -6 F.

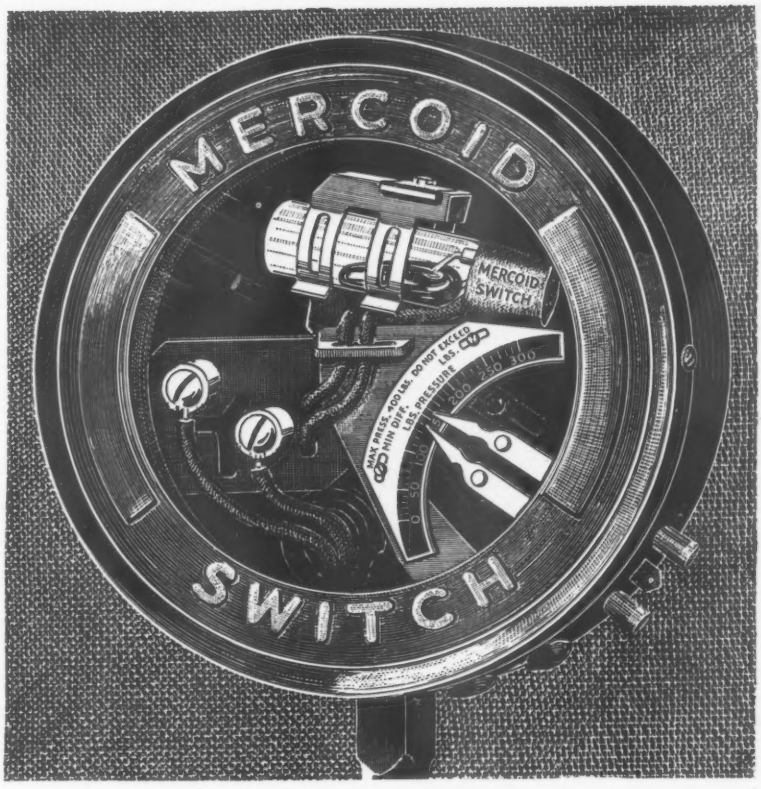
"Dry Ice" is commercially obtainable in 10 inch cubes weighing about 50 lb. It takes 247 Btu to sublime one pound of "Dry Ice". (Sublime is the term used by chemists in referring to the change of a substance from the solid to the gaseous state without any evidence of its going through the liquid state.) Because of the large heat-absorbing capacity that is available in a very small amount of the material, "Dry Ice" is an efficient means of quickly producing and maintaining a temperature of about -80 F in metals with which it is in contact.

The shrinkage obtainable depends in part upon the initial temperature of the material to be shrunk: it will be less when the initial temperature is already low than when it is high.

It is not practical to depend on utilizing more than half of the contraction, for the reason that a cooled part will warm up quickly in handling (by means of tongs) and by contact with the warm recipient part.

Place the object to be cooled, together with the "Dry Ice," in an alcohol bath. This permits a more effective transfer of heat. Furthermore, the film of alcohol around the cooled part, when the latter is taken out of the bath will act as a lubricant when making the fit and will prevent frost from forming on the part.

The Locomotive



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Plant Engineer's Library

Management Techniques for Foremen—Questions and Answers for All Supervisors, by Richard W. Wetherill; copyrighted 1946; 8½ by 11 in.; simulated leather, loose leaf, ring binding; published by National Foreman's Institute, Inc., Deep River, Connecticut. Price $7.50.

This is a manual of instructions for men who have the responsibility of directing others in their work. The book has gathered together in it a large number of articles dealing with subjects which proved of interest to foremen and is arranged in sections which may be referred to readily. The author does not claim that the manual is complete, not every foreman will have responsibilities for which it covers, however, some will have more, but material in these pages is based on many training sessions conducted by or under the direction of the author. The section headings included are as follows: responsibilities, information, lining up a job, introducing people, training, safety, quality, cost, quantity, physical property, working conditions, managing people, rate problems, labor relations, discipline, leadership, co-operation and advancement. The book is full of short, concise paragraphs giving the principles which have been found successful in the management of workmen and if you are foreman or engineer managing the activities of a group of workers you will find this manual extremely helpful to you in the handling of men and their work.

60 Years with Man and Machines, by Fred H. Colvin in collaboration with D. J. Duffin, copyright 1947; first edition; 6 by 9 in.; 297 pages, fully indexed; hard cloth binding; published by Whittlesey House, McGraw-Hill Book Co., New York, N. Y. Price $3.50.

Although this book is called an autobiography, it differs from the usual autobiography in that it stresses the author's observations of his personal contact with the development of machinery and industry and the men responsible for that development, rather than a narration of his own accomplishments. It is full of anecdotes, some amusing, some tragic, but all interesting to the person who likes machinery and has a vision of its past, present, and future importance to the welfare of humanity. Mr. Colvin begins his narrative with his apprenticeship in 1884 and carries his observations through to the present time. He has participated in the development of the bicycle, the automobile, the aeroplane and the modern railroad locomotive as well as hundreds of new machines and machine tools. He has known intimately many of the great inventors, scientists, engineers, and industrialists and has witnessed the growth of many of our national scientific and industrial societies. Beginning with a word by Senator Ralph K. Flanders the book is then divided into 12 chapters, the headings of which are entitled: The Machine That Can Reproduce Itself, In the Beginning Was the Belt Drive, Giving the Machine a Voice, A Society Sponsors the Machine, High-Wheelers and High Iron, Natural History of the Automobile, I Join the American Machinist, From Maxim to the Jet Plane, Machine Tools and the First World War, Tour of the World in Eighty Days, Machine Tools and Global Warfare, Past, Present and Future. The following paragraph written by Senator Flanders truly characterizes the author and the importance of his biography to the men in industry: "Fred Colvin occupies an unique position in the machine-tool industry. He has seen in his lifetime the transformation of that industry from an accessory of industrial development to firm establishment as its foundation. He has watched the development of the machine tool from a simple means of getting useful things done to the point where it embodies in its design and operation the transfer of the skill of the exceptional mechanic and engineer, in usable form, into the hands of thousands and millions of operatives. It is this function of the transfer of skill that has made our nation supreme among the nations of the world in industrial might." This book is almost an outline of the history of machine development over the past 50 years and is told in a very interesting narrative form which is sure to be enjoyed by engineers and machinists who read it.

Specifications and Tests for Electrodeposited Metallic Coatings, prepared by Technical Committees representing the American Society for Testing Materials and American Electroplaters' Society, copyright 1946; size 6 by 9 in., 52 pages, paper cover; price $1.25; published by The American Society for Testing Materials, headquarters 1916 Race street, Philadelphia 3, Pa.

In the presentation of these standards, the sponsoring societies state that this publication has been compiled to collect all of the ASTM specifications and methods of tests pertaining to electrodeposited metallic coatings on metals so as to have all of them together in a convenient form for the use of the industry. The specifications and methods of test are given in their existing form at the time of publication of this compilation but some of them are tentative with the possibility that they may be changed before adoption as standard and any of them may be revised from time to time as required. The publication contains specifications for electrodeposited coatings as follows: Zinc on Steel; Cadmium on Steel; Nickel and Chromium on Steel; Nickel and Chromium on Copper and Copper-Base Alloys; Lead on Steel and Chromate Finishes on Electrodeposited Zinc, Hot-Dipper Galvanized, and Zinc Die-Cast Surfaces. In addition to these specifications the publication describes methods of test for local thickness of electrodeposited coatings and the testing of salt spray. Also contained in the publication are recommended practices for chromium plating on steel for engineering use, and low-carbon steel for electroplating. The publication should be of extreme value to all electroplaters, particularly those whose work must hold up to specific requirements.

Lighting Handbook. Produced by Westinghouse Lamp Division's commercial engineering department; 260 pages, 7⅞ by 4¼ in., bound in a flexible leatherette cover. Available from Westinghouse Advertising and Sales Promotion Department for $2.00.

This revised edition of the company's Lighting Handbook is an authoritative reference work for anyone associated with engineered installations. The book contains a variety of technical data designed to aid illuminating engineers, utility lighting specialists, architects, contractors, consulting engineers and others. One of the

highlights is a newly-developed precalculated foot-candle table which covers seven pages. By using this table lighting men can predict easily and accurately the results to be obtained by most any type of interior lighting installation with a minimum of mathematics.

Each chapter in the book is numbered separately and a "quick-find" index in the form of labeled tags is provided.

The Atomic Story. By John W. Campbell. First edition. 297 pages, 5½ by 8½ in., cloth. Illustrated. Published by Henry Holt and Company, Inc., New York, N. Y., 1947. Price $3.00.

This is by far the best book on atomic energy thus far published. It presupposes no knowledge whatever of nuclear physics, yet, after reading it, one will know all that an ordinary person, not a physicist, can know of the subject of atomic energy. Clear, simple, intensely interesting, the book takes the reader through every phase of the development of atomic energy from start to finish.

Since the atomic bombs were dropped on Hiroshima and Nagasaki, a little over two years ago, some dozens of popular books have appeared, all attempting to give the lay reader an idea of what atomic energy is—how it was developed. Many of these are good, some of them excellent, but none of them tell the whole story in the way this book by Mr. Campbell does.

There is good reason for this, namely, the author himself. It is by no mere streak of fate that he turned out such an interesting book. First, he knows his subject; he has always been interested in science; in college he majored in physics with emphasis on atomic physics. Secondly, he knows how to write. He is the editor of a science fiction magazine and believes that truth is not only stranger than fiction but that fiction has difficulty in catching up with it.

The Atomic Story is just what its name implies; it is a story, not a treatise. It begins with the once upon a time when Democritus proposed the atomic theory. From there one, it carries you through the entire development of the concept of nuclear energy. It gives you the historical background against which to project the details of the atomic bomb development later on. It tells you about the instruments involved, how they work and how they are used. It gives the clearest explanation of a cyclotron that you will find anywhere.

Nuclear physics, says Mr. Campbell, is far simpler than the game of bridge in its broad basic principles. It takes a lifetime to become a top rank nuclear physicist, but it takes a lifetime of playing to become a bridge master, too. Campbell believes that physics is a perfectly natural and simple thing and his book with its humor and crystal-clear approach, makes the understanding of the atomic story easy for the reader.

You don't have to be an engineer to understand this book, but if you are, so much the better—you will be able to appreciate it even more than the average reader.

You may have read a dozen books on atomic energy. You may have read all the articles published in this magazine on the subject during the past two years, but no matter, you should still read this book. Even if it deals with aspects of the subject you are already familiar with, you will find Mr. Campbell's account fascinating and more than worth while. Strangely enough, in an editorial in the June, 1938, issue of Astounding Science Fiction, Mr. Campbell said, "You can be fairly certain of this: **the discoverer of the secret of atomic power is alive on earth today.** His papers and researches are appearing regularly; his name is known. But the exact handling of the principles he's discovered—not even he knows how. We don't know which is his name. **But we know him. He's here today.**

The bold type appeared in the original editorial in June, 1938. Six months later Hahn and Strassman's discovery of the fission of uranium was announced.

Heating, Ventilating, Air Conditioning Guide 1947; 1,280 pages, illustrated; size 6 by 9 in., cloth binding; published by American Society of Heating and Ventilating Engineers, 51 Madison avenue, New York 10; price $6.00.

The twenty-fifth edition of the well-known Heating, Ventilating, Air Conditioning Guide is announced, its silver anniversary edition.

All of the 51 chapters of The Guide have been reviewed by The Guide Publication Committee assisted by a group of 50 practicing engineers and other authorities who served with the committee. Important changes have been made wherever improvement could be effected either in presentation of material or in addition of useful data.

The chapter on Cooling Load has been rewritten and includes an enlarged list of cities for which summer design conditions are given. Methods of determining components of heat and vapor gain are given in detail for homogeneous and composite walls. A detailed example in determining cooling load is included.

Treatment of Fuels and Combustion has been enlarged. Formulas for heat charts are included for easy determination of flue gas losses. In the chapter on Hot Water Heating Systems and Piping, examples in piping design have been simplified. A formula for sizing closed expansion tanks has been added. Information on use and installation of air cleaners has been added to the chapter on Air Cleaning Devices.

The chapter on Unit Air Conditioners, Unit Air Cleaners, Attic Fans has been rewritten to include improved sections referring to the features of construction and factors influencing operation and application of unit equipment.

Revision of the chapter, Dehumidification by Sorbent Materials

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keeps this chapter abreast of present knowledge and practice in the sorbents field. An example in calculating moisture load is included.

The chapter on Refrigeration includes a description of the air refrigeration cycle; also, the section referring to absorption systems has been simplified.

The Air Duct Design chapter includes a friction loss chart for ducts as small as 1½ in. and a new chart facilitating corrections for pipe roughness.

Revision of the chapter on Marine Heating, Ventilating and Air Conditioning provides new material based on Navy and merchant marine practice. Diagrams of typical marine air conditioning systems are shown.

The chapter on Water Services has been extended to include information on design of cold water piping systems. Charts provide friction loss for both rough and fairly rough pipe.

A complete cross-index of the technical data section is included. Convenient reference to manufacturers' equipment is provided by the catalog data section showing the products of 240 firms, with a convenient cross-index of products available. The guide includes a roll of membership of the Society.

As in the preceding 1946 edition, the subjects treated are grouped in several general sections, under which they are divided into chapters. The sections cover: 1—Principles; 2—Human Reaction to Atmospheric Environment; 3—Heating and Cooling Loads; 4—Combustion and Consumption of Fuels; 5—Heating Systems and Equipment; 6—Air Conditioning; 7—Special Applications; 8—Installation of Testing Codes.

The Engineer in Society, by John Mills; 196 pages; size 5½ by 8 in.; cloth binding; published by D. Van Nostrand Co., Inc., 250 Fourth avenue, New York; price $2.50.

The author of this book is a well known interpreter of science to the layman, having published many magazine articles on various technical subjects and written two fine books "A Fugue in Cycles and Bels" and "Electronics: Today and Tomorrow." The present book, he says, started out to be a discussion of the problems engineers need to solve in publishing and writing technical material so that ordinary people can understand it.

However, the book soon turned into a discussion of what kind of man the engineer is and what his place is in society. For those two things, more than anything else, determine largely the way in which he expresses his ideas.

It should not have required the development of an atomic bomb to direct attention to the political importance of science and engineering, the author points out. Yet these recognitions are by-products which may prove to be more influential than the bomb itself. Science, he maintains, has in its methods and objectivity a promising, untried technique for the solution of social problems which have been amplified by the elimination of remoteness from geography. It will take time to organize scientists and engineers for this task and to obtain public acceptance of their efforts. If this book can help to shorten the time, it will have fulfilled the hopes of the writer.

He begins by discussing what manner of men engineers are and what their function is in society. Most people are either S or D types and the author's proof of why a man is either an S type, who sees similarities between things, or a D type who sees differences, is important in finding out whether or not a man belongs in the proper group in industry. This leads to a consideration of the wrong man for the right job and of just what engineering aptitudes consist of. This is based on a great deal of work the author did in recruiting new members for the technical staff in Bell Telephone Laboratories. (He has been with the telephone organization in one capacity or another for the past 35 years and before that was a university teacher for 10.)

He then discusses the dietetics of jobs, showing what proportions of individual, creative, mental and physical routines and of collective work, involving contacts with superiors, equals or inferiors, constitutes a balanced ration in work. He then discusses the attitudes of research workers. The second part of the book deals with Scientists Gone Executives. Then come chapters on Salary Progress for Scientists, Scientific Labor and Management, Scientific Men of Good Will, Organizing for Evolution.

The latter part of the book begins to deal more with some of the details of the engineer's writing and speaking. There is a chapter on the Art of Thought, The Curve of a Growth, followed by a chapter on Persuasive Exposition.

Too many engineers says Mills, think it beneath the dignity of their profession to make their conclusions effective by good writing. Persuasive writing is not necessarily dishonest. Yet when the facts are known and honest conclusions are drawn from them, it is an advantage to society to have them put into effect. Persuasive writing is little more than clear writing, which makes all the difference. It persuades to comprehension.

Practical Design Handbook for Engineers, by Dr. Alois Cibulka; 501 pages, illustrated; size 9½ by 12 in., paper cover; published by Dr. Alois Cibulka, Highlands, Texas; price $6.00.

Calculus for Practical Engineers, by Dr. Alois Cibulka; 100 pages, illustrated; size 9½ by 12 in., paper binding; published by Dr. Alois Cibulka, Highlands, Texas; price $3.00.

The first of these books, the Design Handbook, is one of the most interesting compilations of engineering information we have seen. The author quotes as his motto the dictum of Marcus Aurelius: "Do not act as if you had a thousand years to live." Acting on that maxim, he wrote the book for those engineers, including himself, who like to do the most in the shortest possible time and then go fishing or otherwise enjoy life.

The Design Handbook is primarily a compilation of all the fundamental principles, tables of data, and dozens of charts, required in several important fields of design. Part I covers the general theory and practical calculations for concrete, steel, and timber structures and steel and aluminum shapes.

Part II is devoted to a discussion of modern welded steel structures and to the "RST" system of re-enforced-steel-timber construction invented by the author, who is also head of the RST Engineering Co. He shows how this system of construction can be adapted to bridges, roofs and many other types of structures. His discussions of steel work and concrete construction are illustrated with detailed diagrams and tabulations of the factors involved. A number of pages are devoted to a study of rigid frames and statically indeterminate structures.

Part IV covers pressure and vacuum vessels and piping, giving charts for heads and shells of pressure vessels, data on pressure piping, transite pipe, lead pipe, equivalent flow capacity of pipes, condenser tube data, etc. In this section, special emphasis is laid on the design of piping used in chemical plants and oil refineries.

Tables and standard dimensions for all types of valves and pipe fittings, based on the Code, also standard fittings shown in the Crane and other handbooks, are given in detail.

Part VI gives detailed data on shafts, gears, belts. Part VII covers hydraulics, pumps, heat transfer, insulation, steam, ammonia. Properties of steam, vapor and fluids are shown, with many of the practical design tables, charts of pumping data and the like. Part VIII covers the characteristics and engineering factors required in dealing with oils, hydrocarbons and chemicals. Part IX covers aerial cable, tram ways, drilling rigs and guy lines, and Part X gives mathematical tables, conversion tables, curves, construction of monographs, hyperbolic functions, tables of integrals, etc.

The author emphasizes designing not only for proper strength and function, but with forethought to prevent obsolescence and also with thought to the convenience of the men who must operate the equipment.

The author's other book on the calculus is designed to explain integration and differential equations clearly and rapidly, and shows how the processes of the calculus can be used in solving actual engineering problems.

Concise Chemical and Technical Dictionary, edited by H. Bennett; 1,055 pages, illustrated; size 6 by 9 in., cloth binding; published by The Chemical Publishing Co., Inc., 26 Court street, Brooklyn 2, New York; price $10.00.

Written for both professionals and laymen, this book contains definitions of many internationally accepted terms. It contains data useful to many people in the business world who see technical expressions freely used in newspapers, magazines and advertisements, and need to know their meanings without the

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necessity for a complete technical education. To the chemist and technician also, the book should be useful in promoting general understanding in various countries.

General rules for pronunciation of the chemical terms recommended by the ACS and a list of key words with phonetic spelling are features of the book. Another special feature is the listing of thousands of trade names or proprietary products in the synthetic resin, plastic, metal, rubber, textile, food, pharmaceutical, paint and varnish fields.

Conversion tables, discussion of indicators, chemical elements, vitamins, are also given. Under definitions of the words, many helpful cross references are included and arranged so that the desired terms can be located easily.

Chemical composition, uses and properties of a trade name or proprietary product are given in many cases. The book contains a wide variety of information about newly developed synthetic chemicals, important manufacturing processes, raw materials, terms used in radio and television engineering, descriptions of every common or rare chemical.

Applied Atomic Power, by Edward S. C. Smith, A. H. Fox, R. Tom Sawyer, and H. R. Austin; copyrighted 1946; size 6 by 9 in.; 227 pages; hard cloth binding; published by Prentice-Hall, Inc., 70 Fifth avenue, New York 11, N. Y.; price $4.00.

In this book the authors have done a creditable job in explaining what atomic power is and then in discussing how that power may be applied to our every day needs and purposes. It is written in relatively simple language and divided into five parts. The first describes the mineral uranium, its geological distribution and physical characteristics. In the second section atom splitting—the phenomena of fission—is explained and also how it produces atomic energy. In the third part, the book gives a summary of the developments of atomic energy and explains the problems that are encountered in the production of plutonium. The possible methods of converting atomic energy into mechanical power are treated in the fourth section, which is the most valuable portion of the book as it illustrates some of the ways in which the products of atomic energy may be utilized in existing machines and the possibilities of developing plentiful power for peaceful purposes. The book closes with a summary of industrial benefits from the extensive research that preceded the production of materials and some valuable appendices. Those who are not in the very inner circle of research activity during the period of the development of atomic fissions will appreciate this recent book which puts in the most simple language possible the theory back of atomic fission and an outline of the history of the development of this most recent scientific discovery. The reader of this book will find it not only informative but stimulating and helpful in fixing in the mind the theories back of atomic fission which have proven to be the correct ones to apply in the generation of atomic energy.

Proceedings of the Mexican-American Conference on Industrial Research, copyright 1946, size 6 by 9 in., 176 pages, paper binding; published by The Armour Research Foundation of Illinois Institute of Technology; price $2.50.

This volume contains the Proceedings of the Mexican-American Conference on Industrial Research held under the auspices of Armour Research Foundation, September 30 to October 6, 1945. This Conference was the first to be held on industrial research between any two industrial nations. Its purpose was to demonstrate research in action from pure science at the University of Chicago to the typical laboratories of industry. The position and contribution of the government in national research activities were illustrated by a visit to the Forest Products Laboratory in Madison, Wisconsin. The participation from Mexico was representative of government, with a number of distinguished departmental engineers personally appointed by President Comaches of banking, of industry and of commerce. Two or three corporation lawyers and the Minister of National Economy were included in the delegation. The addresses and discussions included: The Industrial Research Pattern of the United States, by Harold Vagtborg; Integration of Industrial Research and Education, by Lin ton E. Grinter; Fundamental Research in College and University Laboratories, by Walter Bartky; The Organization, Management and Effectiveness of Institutional Research, by E. R. Weidlein; The Armour Plan for Industrial Research, by Jesse E. Hobson; Trends in Engineering Education in the United States of America, by A. A. Potter; Industrial Research as Viewed by General Electric, by L. A. Hawkins; The Research Program of Universal Oil Products Company, by Gustav Egloff; The Development and Role of Dairying in Wisconsin, by K. G. Weckel; Investigations in Animal Nutrition, by Edwin Bret Hart; Breeding, Feeding, and Management of Dairy Cattle, by E. E. Heizer; Pasture Problems, by L. F. Graber; Research in a State University, by I. L. Baldwin; Agricultural Research Serves the Public Welfare, by Noble Clark; The American Standards Association, by George S. Case; The National Bureau of Standards, by E. C. Crittenden; The Value of Standards to American Industry, by David Levinger; Science, the International Language, by Arthur H. Compton; Newer Developments in Medicinal Research, by E. H. Volwiler; Technology on the International Front, by Maurice Holland; The Management of New Industrial Enterprises on the International Front, by George H. Houston; Financing New Industry on the International Front, by James Drumm; and Discussion by Mexican Guests. Industrial research as a profession is young in years, but co-operative conferences such as this are bound to have beneficial results on the economy of the nations participating in such conferences.

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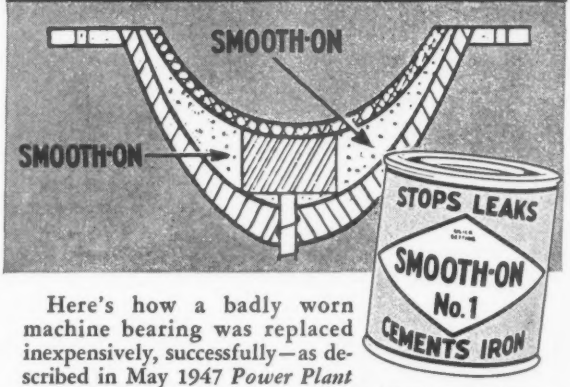

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Letters from the Readers

These letters are typical of the many received from a representative group of plant engineers who received advance outline copies of this issue

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"Your idea of a magazine devoted to information on plant engineering should fill a definite need, especially for the younger men who are entering this particular field of mechanical engineering. Plant engineering, as I have come to know it through the years, requires a broader knowledge of engineering than any other branch of the profession. Your list of articles is good; but I believe it should be expanded to include data on maintenance, cost control and scheduling of jobs."

W. F. Moridge, Consulting Engineer
Clark Equipment Co.

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"If every issue covers the field as well as the outline for November, this magazine should be of untold worth to us."

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Pepperell Manufacturing Co.

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"Being concerned with the supervision of plant personnel, the maintenance of buildings, the selection and operation of mechanical equipment, I believe that PLANT ENGINEERING will have top reader interest for those engaged in similar work."

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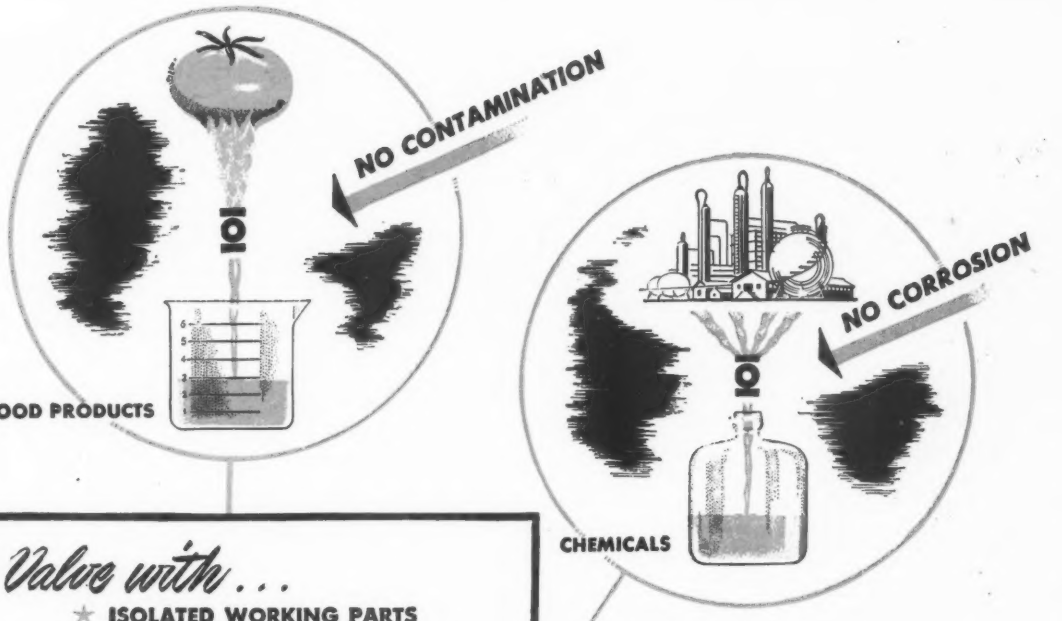

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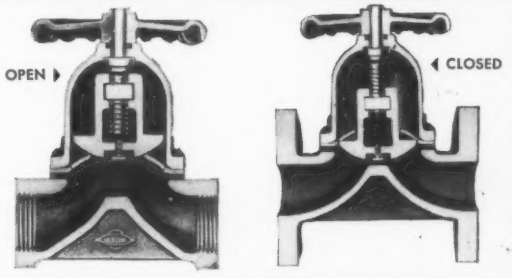

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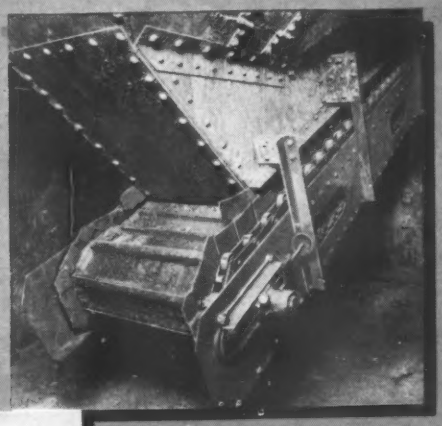

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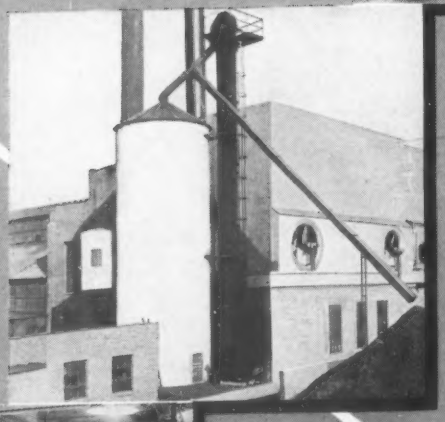

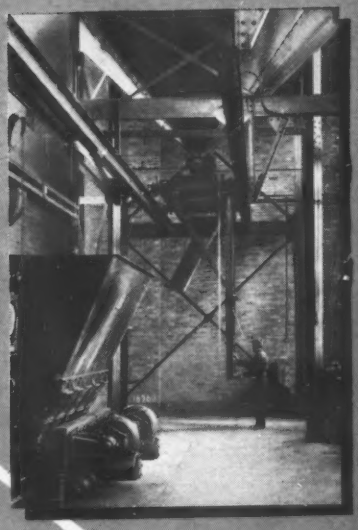

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